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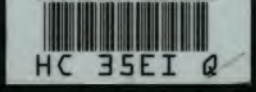
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THERAPEUTICS

OF

DRY HOT AIR

WITH A CHAPTER UPON THE INCANDESCENT ELECTRIC LIGHT

BY

CLARENCE EDWARD SKINNER, M. D., LL. D.

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THIRD EDITION

Thoroughly Revised to Date

PUBLISHED BY

FRANK S. BETZ CO.

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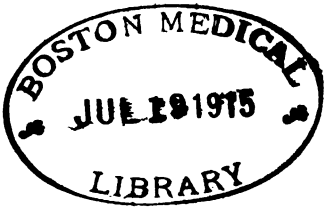
1914



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CLARENCE EDWARD SKINNER

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DEDICATED

TO THE MEMORY OF THE LATE

DR. HEMAN BANGS SMITH,

WHOSE PERSONALITY, RICH IN THE UNCONSCIOUS NOBILITY OF TRUE MANHOOD, AND OVERFLOWING WITH THE MILK OF HUMAN KINDNESS, WILL ALWAYS BE RECALLED WITH DEEP AFFECTION BY THE AUTHOR.

PREFACE TO THIRD EDITION.

IT is with deep gratification that the writer has noted the progress in therapeutic popularity which dry hot air has made during the nine years which have elapsed since the last edition of this book was published. The development and establishment upon a sound, logical basis of this remedial measure have occupied his attention and effort in very large degree during the past fifteen years, and when he was called upon to prepare a third edition of this treatise he felt that his labors were thereby demonstrated to have begun to bear fruit of some material value.

A chapter upon the incandescent electric light has been added in this edition because of the growing popularity of this therapeutic agent. We do not approve of substituting this treatment for the body dry hot air treatment, but there is some reason to believe that the *local* incandescent electric light application may ultimately displace the local dry hot air application in some local pathological conditions.

The contributions to medical science since the last edition was published, which have been most significant as far as thermaerotherapy is concerned, are those touching the bacteriology and therapy of infection. These have illuminated many problems connected with this subject, the monumental work of Sir Almroth Wright in particular ("Studies on Immunization") elucidating the rationale of the wonderful effects frequently producible with dry hot air, in a gratifying manner.

The book has been largely rewritten so as to embody and conform to these advances in knowledge which, the writer hopes will obtain for this revision the same pleasant reception which has been accorded to the earlier editions.

C. E. S.

NEW HAVEN, CONN., *July*, 1914.

PREFACE TO SECOND EDITION.

For several years past the writer has felt that new forces were coming to the front in the therapeutical world, that were destined in a few years to revolutionize the current methods of treating many disease processes and to greatly increase the inherent efficacy of others; we refer to the so-called "physiological" forces, heat, cold, electricity, the various forms of radiant energy, etc. The first edition of this book was written for the purpose of bringing before the profession one of these forces which the writer's experience had convinced him was destined to become one of the foremost in therapeutical importance and utility, and which was known and understood by but a very small number of medical men. The conviction that a book upon dry hot air would fill an urgent want has been fully confirmed by the manner in which the first edition was received and which has encouraged the author to omit no pains in order that this, the second edition, shall be complete in every respect.

Although the general plan and scope of the work, as embodied in the first edition, remain the same, yet the addition of matter pertaining to many small but important details, and several illustrations which were needed for complete elucidation of the text, has increased somewhat the size of the volume. As the subject-matter has been entirely rewritten and rearranged, however, this increase in size does not interfere with accessibility to the contents, and accessibility is still further facilitated by the exhaustive character of the table of contents and the index.

The plan of mentioning briefly the other remedial

measures which it is advantageous to employ in conjunction with dry hot air, has also been retained. As stated in the preface to the first edition, this agent "is not an universal panacea. It is simply a rational therapeutic element which, alone or in combination with other remedial agents, will increase greatly our power to overcome pathological processes. In order to appreciate its true value, therefore, it must be viewed in its various therapeutical relations, not alone."

At the suggestion of many who have perused the first edition, a number of additional case reports have been introduced to illustrate and demonstrate statements made in the text. The results obtainable with dry hot air are sometimes so magical as to tax uninstructed credulity to the utmost, hence these illustrative cases have been selected, as far as possible, from among those patients who are now alive and accessible; there is no evidence so convincing as that furnished by one's own senses.

His experience, since the first edition was published, has not led the author to change his opinions on any of the cardinal principles therein set forth, but has resulted, as suggested above, in some amplification and development of those principles; the description of these contained herein he believes adds greatly to the value of the present edition as compared with the previous one.

He desires hereby to thank those who have by apt suggestion assisted him in bringing the work to its present degree of usefulness, and to express the hope that this volume will be as helpful to his colleagues in the future as he has been many times informed the previous one has been in the past.

C. E. S.

NEW HAVEN, CONN., *March*, 1905.

PREFACE TO FIRST EDITION.

DRY superheated air as a therapeutical measure has now been before the medical profession for several years, yet as far as the average practitioner is concerned it is still a new and unknown quantity. Even the latest text-books dismiss it with but a mention, and that only in connection with two or three pathological processes. This general ignorance of the agent is to be deplored, as, when skillfully administered, it is one of the most potent and useful at our command and applicable to many disease conditions wherein the ordinary methods of treatment are unsatisfactory.

In the following pages is set forth what has been ascertained in reference to dry hot air therapeusis up to the present time. It has been considered desirable to mention briefly the other remedial measures which it is advantageous to apply to different conditions in combination with dry hot air, because this agent is not an universal panacea. It is simply a rational therapeutic element which, alone or in combination with other remedial agents, will increase greatly our power to overcome pathological processes. In order to appreciate its true value, therefore, it must be viewed in its various therapeutical relations, not alone. Where necessary to elucidate the manner in which dry hot air produces its effects, the pathological features involved in the condition under consideration have been briefly noted.

Many of the failures to secure satisfactory results with dry hot air have been due to the fact that it has been called upon to influence pathological conditions which were not amenable to its physiological action; others

more numerous still have been due to faulty technique in its administration. These subjects, therefore, have been treated at some length.

It is not to be expected that every general practitioner will or can become a dry hot air expert, but every physician should at least understand the principles of its application and the clinical results derivable therefrom, in order that he may be able to decide intelligently when his patient will be benefited by its use. If he does not care to undertake its actual administration he can send his patient to some one who is an expert.

Finally, too much must not be expected of dry hot air, or any other one measure. It will, alone and unaided, cure some disease conditions; others will require all the therapeutical resources at our command; and in still others even all that we have will not suffice to produce a cure. Its powers, however, are exerted in directions in which remedial agents hitherto known have been very deficient; its addition to the treatment results in benefit to many patients who would fail to improve under other measures alone, and its adoption into our armamentarium enables us to increase by a large percentage the sum total of our power over disease. Any agent possessing these attributes is entitled to respect and study. Dry hot air exhibits them in an eminent degree.

CLARENCE EDWARD SKINNER.

NEW HAVEN, CONN., *October*, 1912.

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THERAPEUTICS OF DRY HOT AIR

CHAPTER I.

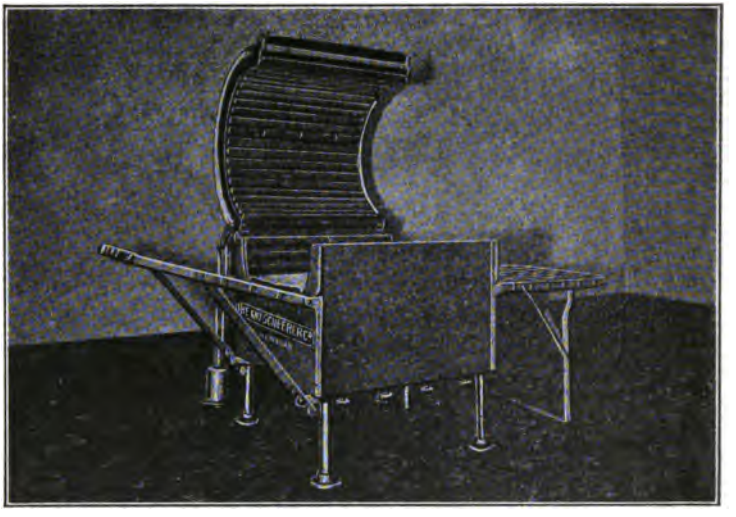
APPARATUS.

FOUR forms of apparatus are essential in order that the most may be gotten out of thermaerotherapy as applied in the practice of general medicine: (1) a large one for treating the whole body at once (the Body Apparatus); (2) a smaller one for treating hands, wrists, arms, backs, shoulders, ankles, and feet (the General Local Apparatus); (3) a short one open at both ends, for treating ankylosed, flexed knees (the Knee Apparatus); and (4) the Dry Hot Air Douche.

The Hopkins Dry Hot Air Douche for use in the external auditory canal and the other open cavities of the body has been designed by Hopkins of Cleveland, Ohio, but this instrument will rarely find a field of application in general medical practice. It will be described in detail, however, in its proper place.

CONSTRUCTION.

The three first mentioned consist in general of metal cylinders lined with some non-conducting material, and are susceptible of being closed at both ends in such a way as to confine the air they contain about the part to be treated. The cephalic end is closed by cloth attachments so constructed as to fit the different regions of the



I.—The Sprague Body Dry Hot Air Apparatus.

II.—Patient Undergoing Treatment in Sprague Body Dry Hot Air Apparatus.

body to which it may be desired to apply the heat; the pedal end by curtains of cloth or a permanent metal stopper.

Gas, gasoline, electricity, and alcohol are used for generating the heat, and high temperature thermometers are placed conveniently for registering the intensity obtained.

There are several makes of apparatus on the market, the therapeutic principle of all being the same, but they differ in construction and price. That manufactured by Frank S. Betz Co., of Hammond, Ind., and the Sprague apparatus made by the Kny-Scheerer Co., of New York, N. Y., are most commonly used in this country. Some very excellent forms of apparatus, notably the "Tyrnauer," are made in Germany, but they are very expensive, and, as practically the same theraputic results can be obtained with the American machines, they will not be discussed further here.

As it is the cardinal principles of construction rather than the details that combine to render an apparatus of this character therapeutically efficient, and as the details of construction can be secured from the different manufacturers without difficulty, only the essential attributes that must be common to all dry hot air machines in order that they shall be therapeutically reliable will be mentioned here; these are as follows:

The Body Apparatus.

This should be capable of generating a heat of at least 300° F. in fifteen minutes and 350° F. in thirty minutes at the outside, and of sustaining it there for at least an hour.

The source of heat should be so arranged that the flame cannot be directed toward the patient without having some non-conducting material interposed, however great the distance between them.

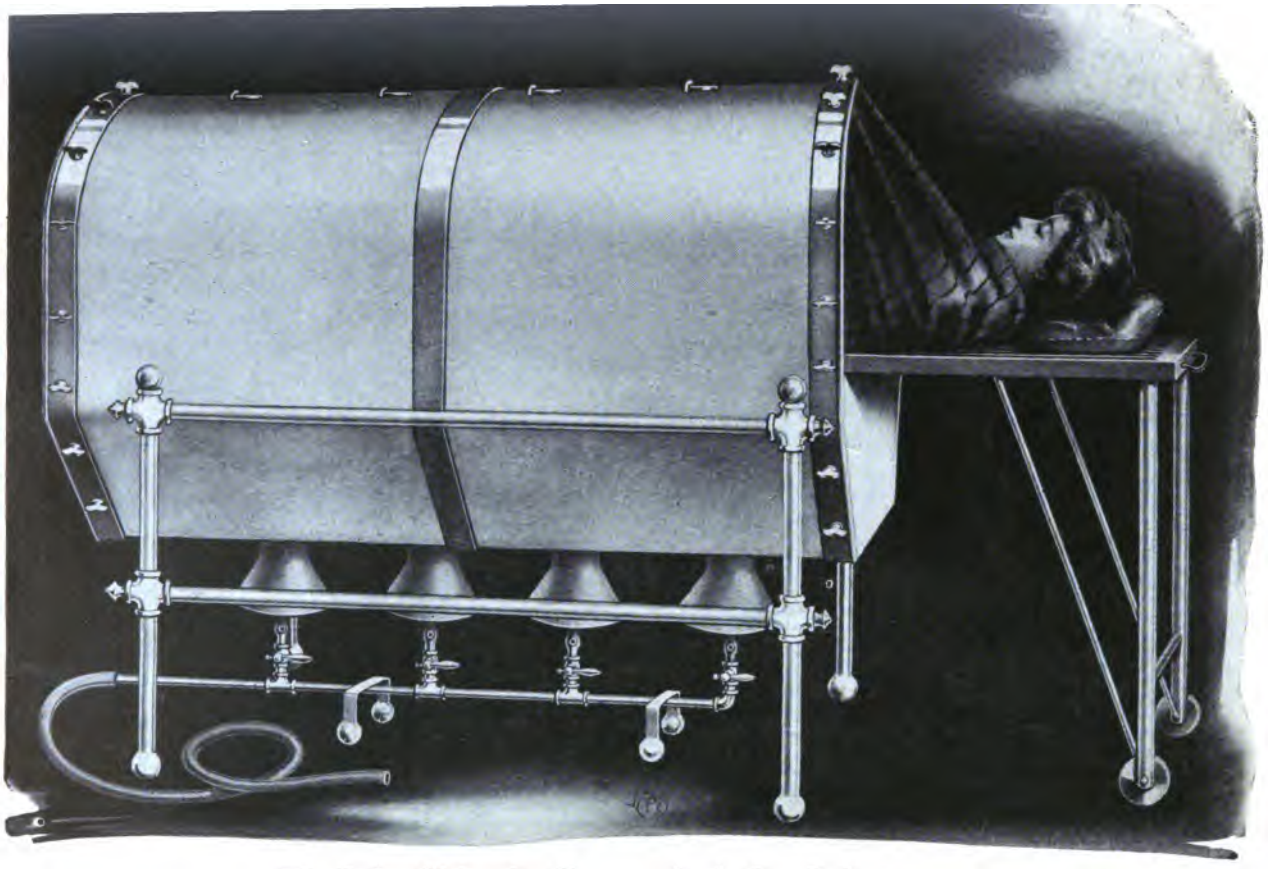
It should be provided with some arrangement, by valves or otherwise, whereby the air may be changed frequently without lessening the heat to any great extent. If free circulation of air in the apparatus is not attainable it will become so saturated with moisture that the skin of the patient will be in danger of blistering.

Because of its size and weight this form of apparatus is not portable, hence is available only when the patient can be brought to it and in sanitariums or hospitals.

When illuminating gas is used for heating this form of apparatus a pipe at least three-quarters of an inch in diameter, and connected directly with the large street service pipe, should be directly available for supplying the burners under the ordinary pressure conditions. With a smaller supply than this it will not usually be possible to secure the high temperatures without which satisfactory results cannot be attained in many conditions.

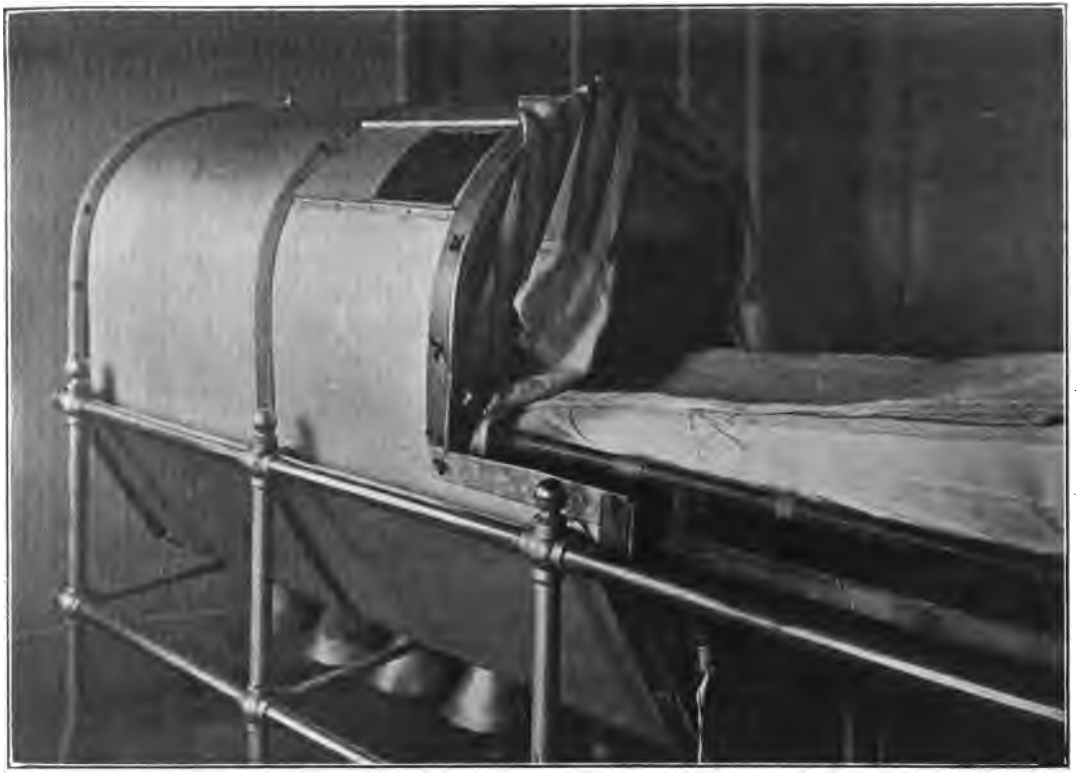
Structural Modification of the Betz Body Apparatus.—There are two forms of body apparatus; one in which both ends of the cylinder are closed by cloth curtains, and the other in which only the cephalic end is so constructed, the pedal end being permanently occluded by a metal stopper. As will be seen in a later chapter, the sensitiveness of the toes of some patients frequently renders it necessary to conduct the application by this apparatus with these members entirely outside of the heat reservoir; hence with the last mentioned form of body apparatus it is desirable to effect some changes in its construction whereby this object may be attained, and the aid of a tinsmith must be invoked.

The whole upper segment of the metal stopper in the pedal end of the cylinder down to a point an inch or two below the under side of the rolling couch should be cut out, so that the end of the car upon which are the patient's feet can be rolled far enough through the pedal end of the



III.—Patient Undergoing Treatment in the Betz Body Apparatus.

IV.—Pedal End of a Modified Betz Body Apparatus.



V.—Cephalic End and Side of a Modified Betz Body Apparatus.

cylinder to allow those members to project beyond the limits of the heat chamber. Curtains of heavy awning cloth should then be fitted to the upper and under borders of the opening thus made, in the same manner as they are arranged at the cephalic end of the cylinder, and of such shape and size as will allow the upper curtain to be tucked around the patient's ankles and the under curtain to be drawn snugly against the under side of the rolling couch. This arrangement answers the purpose admirably and is entirely effectual in preventing undue escape of the heated air.

As the hot air reservoir in the machine with permanently closed end is five feet long, it follows that with patients of medium height the head would be inside the reservoir when the feet were protruded as above, so that it becomes necessary also to cut off about sixteen inches of the cylinder; this is most advantageously accomplished by taking some from each end. Cut IV shows the pedal end of such an apparatus which has been altered in accordance with the above suggestions, and Cut V shows the side and cephalic end. Six inches were cut off from the pedal end and ten inches from the upper half of the cephalic end, as shown in the cut.

Another modification shown in Cut V is the hole in the side near the top; it is seven inches square, fitted with a sliding door, and is used for ventilating the apparatus. The rapidity with which the air is changed may be regulated at will by sliding the door backward or forward so as to increase or diminish the size of the aperture.

The General Local Apparatus.

This is the one most useful to the general practitioner. A very important requirement is that it be portable as it is frequently desirable to employ it at the bedside in some acute diseases.

It should be capable of generating a heat of at least 400° F. in at most thirty minutes and of sustaining it there for at least an hour.

The same conditions as to arrangement of the source of heat with relation to the patient apply here as with the body apparatus, but with more force, because the temperatures used are higher.

VI.—Lentz & Sons' Apparatus for the Local Application of Dry Hot Air.

An arrangement for securing free circulation of the air is also essential in this apparatus. A very serviceable modification consists in having the ventilation valve in the top enlarged to a hole five inches square and fitted with a sliding door; an arrangement similar to that shown in Cut V on the body apparatus.

The Knee Apparatus.

Theoretically the same requirements noted in connection with the two preceding forms of apparatus should apply with equal force to this one; there are practical

VII.—The Sprague Apparatus for the Local Application of Dry Hot Air.

difficulties in the way of securing the higher degrees of heat, however, which will be noted and discussed in the chapter on technique.

Internal Distribution of Heat.

An essential of prime importance as regards efficiency in all these forms of apparatus is that the heat should equalize itself within narrow limits in all localities inside of the reservoir after the apparatus is thoroughly heated. Schreiber conducted a series of thermometric observations with some dry hot air machines of foreign make and ascertained that a difference sometimes obtained between the temperature of the air which actually came in contact with the patient, and that in the locality ordinarily occupied by the thermometer, of fifty per cent. of the thermometer reading. A construction producing such conditions renders the apparatus entirely unfit for therapeutical purposes. The discrepancy should not exceed five per cent. of the thermometer reading with a body apparatus, or fifteen per cent. with one designed for local applications and thermometeric determinations made by the writer demonstrate that these limits need never be exceeded. In apparatus of American manufacture they are not usually reached. The simpler the design of the machine the more effectually will the convection currents effect a thermal equilibrium.

Elimination of Moisture.

It has been suggested that dryness of the air in the cylinders might be maintained by the use of some absorbent substance inside the apparatus, or by passing a static electrical discharge through a tube located in the interior of the reservoir whereby the moisture would be precipitated upon the tube; by such means temporary slight irregularities of temperature caused by changing the air in the apparatus might be avoided. To dispose

of the point it is only necessary to consider that at the high temperatures necessary for therapeutical purposes no chemical is known that would retain the moisture even if it were possible for it to absorb it under such conditions, and however successful we might be in precipitating the moisture by electrical or any other means, it would inevitably vaporize again immediately upon coming in contact with a solid body so heated. Changing the air, therefore, is the only practical means now available for maintaining dryness, and the efficiency and convenience of the procedure are such that no other need be sought for; its actual influence in disturbing the treatment temperature after the apparatus has once become thoroughly heated is found in practice to be entirely negligible.

Fire-Proof Cloth Fittings.

Although reasonably close observance of the cautions which will be detailed in the chapter on technique will eliminate any danger of serious ignition of the cloth attachments of the machines, yet scorching will occur which greatly shortens their periods of usefulness. This disadvantage may be obviated or lessened by substituting asbestos cloth for the fabric ordinarily used in their construction, or by treating the attachments before they are used with some fire-proofing solution, the following being a fairly efficient example; it is known as the "Home Office Method," and is used by the explosives department of the British Home Office for fire-proofing inflammable substances:

Sodium tungstate (normal salt) 4 ounces or q. s. to make Sol. Sat.

Water, 30 ounces.
Dissolve in the cold and add
Sodium phosphate, 2 ounces,
Water, 6 ounces,
or a sufficiency of water to make the specific gravity of the solution 1140.

The fabrics are soaked in this solution about half an hour until thoroughly saturated therewith, placed in the apparatus without being squeezed so as to retain in the meshes of the cloth all of the solution that can be held therein, and heated at 350° F. to remove the organic acid and cause the tungstate precipitate to be formed in the fiber, until dry.

The use of asbestos cloth is the most satisfactory, as it eliminates absolutely any possibility of ignition. The fire-proofing solution lengthens considerably the life of the fittings, however, and is less expensive.

When asbestos cloth is used for the curtains of the body apparatus or the various attachments of the local machine, the wear upon it will be greatly lessened by having a layer of ordinary awning cloth outside of the asbestos, thus making a curtain of double thickness, the inner layer being of asbestos and the outer of awning cloth.

In some body machines inflammable material, as wood, is used in the construction of the couch upon which the patient lies. After a while this will burn out, when it may advantageously be replaced with heavy wire netting fastened to the couch at the ends and supported midway, where necessary, by thin iron bands running transversely with their ends fastened to the sides of the couch. This arrangement presents the advantage of forming a flexible surface which gives considerably to the prominent por-

tions of the body, whereby the patient is rendered much more comfortable.

Source of Heat.

As already stated, gas, gasoline, electricity, and alcohol are used to excite dry hot air generators, and which agent is selected will depend upon the facilities obtainable by the individual operator. If electricity is used the heating power of the current should be utilized through a *non-luminous* resistance and *not* through the medium of incandescent lamps.

Gas is the most frequently available, is very convenient, entirely efficient, and exhibits but one disadvantage. In some cities the pressure under which it is delivered, and in some houses the total supply capacity, are not great enough to furnish adequate heating power for the high temperatures frequently necessary of attainment, and if one applies many treatments outside of his own specially equipped operating room, this point assumes an aspect of considerable importance. The difficulty may be overcome by always using gasoline (special gasoline burners and other fittings necessary when this agent is used will be furnished upon specification, by the manufacturer) when giving a treatment at the home of a patient, instead of depending upon the gas supply in the house. Strict adherence to this rule will eliminate many exasperating bedside disappointments.

If the apparatus and treatment room are susceptible of proper ventilation, the possible deleterious influence upon the patient of aërial contamination by products of combustion developed by the bare flames of gas-burners, sometimes urged against the use of gas for this purpose, will be entirely negligible.

Special Chair for Local Application to Shoulder.

Although dry hot air may be applied to this region with the patient reclining upon an ordinary chair or couch, yet it will be found conducive to the comfort of both patient and operator and to the efficiency of the treatment if a chair especially adapted for this purpose is at hand. Cut VIII shows the front view of such a chair and also its lateral aspect. It is made upon the principle of a steamer chair, the frame being of wood and the support for the occupant of canvas. When an ordinary chair or

VIII.—Special Chair Devised by the Author for Use in Administering Local Dry Hot Air Treatments to the Shoulder Joint.

couch is used the cloth attachment connecting the apparatus to the shoulder will be crushed against the body when the patient leans back and the heated air will thus be prevented from reaching the posterior portion of the joint; if the patient leans far enough laterally to overcome this condition his position will shortly become irksome. The sharp backward curving of the side-pieces and the shaping of the canvas back at the level of the shoulders shown in Cut VIII obviate this difficulty entirely and render it possible to carry the heat as far toward the median line as the inner border of the scapula.

Location of Apparatus.

Local.

Little need be said as to the setting of the local dry hot air generators except that the comfort of both patient and operator will be enhanced if the room wherein the treatment is to be given is provided with a window which can be opened during the application. The great majority of these treatments can be given at an ordinary bedside as conveniently as in a room especially prepared for the purpose.

General

The greater size, hence greater heating and deoxygenating capacity as regards the air of the room, of the body apparatus, however, renders free ventilation by open windows or otherwise an essential feature of the apartment wherein these applications are to be administered, and, in the summer time at least, an electric fan, so arranged that the breeze can be directed upon the patient, will be found to constitute a most desirable feature of its equipment.

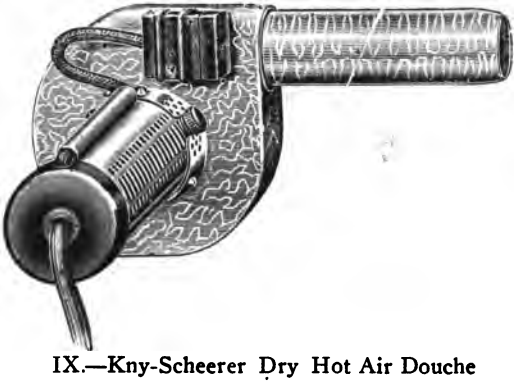
It is also desirable to have the bathing facilities as

near the treatment room as possible so that the patient will not have far to go after cooling. A couch upon which the patient can be given an alcohol rub and left to rest for several hours after the treatment, should be located in a room conveniently accessible from the bathroom.

Other minor details will suggest themselves as the individual operator develops his facilities.

The Dry Hot Air Douche.

This apparatus consists of a chamber containing an electrically driven fan and a tube about an inch in diameter opening from this chamber, which receives, delivers, and



IX.—Kny-Scheerer Dry Hot Air Douche

directs the air to the field of operation as it is forced through it by the fan. An electrical resistance is so located inside the tube that the ourrent of air is driven through it and heated during its passage. We are thus enabled to combine the application of what may be termed "pressure-percussion," with that of heat.

The instrument is easily operated. Turning the switch once starts the fan and delivers cold air, turning the

switch again directs the electric current through the resistance which thus becomes hot and causes the instrument to deliver hot air. It is easily portable and can be

X.—Betz Dry Hot Air Douche

connected with an ordinary electric light socket, hence it is available in a large number of painful conditions in which heat is helpful, and in connection with neuralgia and neuritis occurring in locations inaccessible to treat-

ment with the other dry hot air machines (the scalp for instance) it is invaluable.

Aural Dry Hot Air Douche.

A number of devices have been employed for the purpose of applying dry hot air to the middle ear and in the external auditory canal and the other open cavities of the body, but the Hopkins heater, or aural dry hot air douche, is the best one that has come under the writer's notice. The very excellent results reported from its use (see section on "Otitis") demand more than a passing mention of the apparatus. It is made in three forms so that alcohol, illuminating gas or electricity may be utilized as the source of heat. The air is compressed before being heated so that it is delivered to the field of operation with considerable force.

The Alcohol Heater.—This form consists of a metal cone segment, around the inside of which is wound a tapering coil of copper tubing. Beneath it is an alcohol lamp which heats the coil to a high temperature in a few minutes. Compressed air from a tank, pump, or bulb enters the heating coil at the bottom through rubber tubing, and leaves it at the top through a metallic delivery tube having two rotary joints which make it adaptable to any position of the patient, the delivery tube terminating in a vulcanized fiber ear-tip shaped somewhat like an ear speculum. This ear-tip is said not to become inconveniently hot even when the hottest air is passing through it. The capacity of this heater as regards temperature elevation of the air de-

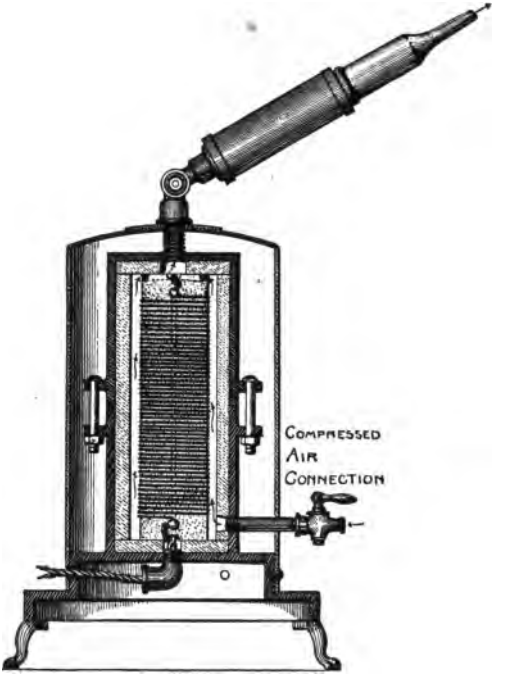
livered is said to be much less than that exhibited by those utilizing gas or electricity.

The Gas Heater.—This form consists of a blue-flame burner, over which is similarly arranged a larger coil of copper tubing, and the compressed air enters and leaves the coil in the same manner.

XI.—Electric Heater.

The Electric Heater.—This machine is operated by the 110-volt lighting circuit through an ordinary socket and plug and can be used on either the direct

or alternating current. It consists of an air-tight tube holding within it a coil of wire which is heated by the current. This tube is surrounded by a nickel plated envelope, the intervening space being packed with asbestos. The wires enter the tube at the bottom



XI *A*.—Cross-Section.

through a bushing. The compressed air enters the tube at the bottom and leaves it at the top as with the alcohol and gas heaters. Air passing through this appliance acquires its maximum temperature elevation (over 400° F.) in eight minutes.

A marked advantage exhibited by the Hopkins machines is that the compressed, heated air is compelled to escape, with a degree of force which is absolutely controllable, at exactly the spot desired and nowhere else.

Directions for setting up and operating all of these outfits, together with complete fittings and descriptions thereof, are furnished by the manufacturers.

CHAPTER II.

PHYSIOLOGICAL ACTION.

FOURTEEN years ago Professor Horatio Wood of Philadelphia made the statement that the results of dry hot air treatments in some pathological conditions were "Almost miraculous." This property of sometimes doing miraculous things has been very largely instrumental in preventing the profession at large from becoming familiar with thermaerotherapy. The claims of its advocates have seemed to be unjustifiable, impossible, altogether too good to be true, but a study of the physiological action of the agent will do much to eliminate the incredulity with which its accomplishments are regarded by those unfamiliar with its clinical use.

Comprehension of its therapeutic applicability to different disease processes, of the rationale of its action, and of the value of the services it renders will be facilitated if the following is borne prominently in mind while considering this subject, viz., that in at least a large majority of pathological conditions Nature's attempt to rid herself of disability is simply and solely through an exaltation, direct or indirect, of the normal metabolic processes. The greater the facility and vigor with which normal tissue changes are carried on the greater will be the individual's vitality, hence capacity for resisting influences antagonistic to his well-being and of overcoming the results of such influences if he should become a victim thereto.

DIFFERENTIATION FROM OTHER METHODS OF ADMINISTERING HEAT.

Electric Arc and Incandescent Light Baths.—A most important point to be borne in mind in this connection is that dry hot air is not radiant heat or moist heat. The physiological influences of the electric arc and incandescent light baths are radically different in several respects from those of the dry hot air application proper, the former being a combination, in varying proportions and degrees of intensity, of both heat and light effects, the radiant element being always predominant, however. With the dry hot air application, properly so called, we do not get any of the characteristic effects of light waves upon cell life, and clinically, the work of Cleaves, Crothers, and others would seem to indicate that the radiant heat bath differs radically in at least one particular from its non-luminous congener, viz., in its greater power of producing sedation of the irritable nervous system.

The purely thermal element in the radiant heat application is necessarily much less intense than in the dry hot air application proper because of the predominance of the luminous rays in the former. We should expect, then, that radiant heat would not be able to perform the work of dry hot air, and that the latter would fail in some respects to accomplish the results attainable with its radiant relative, and experience proves this to be true. The explanation of the difference in the physiological influences characteristic of dry hot air as compared with those producible with radiant heat, is found principally in the greater power exhibited by dry hot air to induce elimination and to influence by reflex stimulation the deep nerve centers.

Hydrotherapy.—Its physiological effects must also be differentiated from those of the various hydrotherapeutic procedures in which a greater or less degree of heat is

employed. In the latter the degrees of heat administered are necessarily much less than with dry hot air applications proper because they are applied by means of water, and the physiological effects of mild degrees of heat are in some respects directly the reverse of those obtainable by the use of high intensities. In addition to this we have to reckon, in some of the hydriatic modalities, with the element of percussion, which still further modifies any possible resemblance that might otherwise obtain.

The differences in the elements which combine to produce the characteristic influences obtainable by the use of these three methods of applying heat, then, are sufficiently marked to constitute radical differences in the spheres of action of dry hot air, radiant heat, and hydrotherapy, and in the securing of a satisfactory therapeutical result the selection becomes a matter of importance; they are by no means mutually interchangeable.

VARIETIES OF APPLICATION AND NOMENCLATURE.

There are two varieties of dry hot air applications; one where the greater part of the body surface, sometimes the whole of it up to the neck, is subjected to influence and which is denominated the "General Application" or "Body Treatment," and the other where only the part involved in a pathological process is included in the field of operation, and which is denominated the "Local Application" or "Local Treatment." The physiological actions of these two varieties of administration differ from each other in degree and to a certain extent also in kind; we will, therefore, consider them separately, beginning with the major procedure.

GENERAL APPLICATION.

Clinical and laboratory observations made in connection with over eleven thousand body treatments given

under the supervision of the writer, have demonstrated that the following phenomena are susceptible of immediate induction by this modality, and that they persist with decreasing intensity for from four to forty-eight hours, rarely longer, the time varying in different diseases and with different patients.

The Heart.—The effect upon this organ is essentially stimulant. There is more forcible systole, more blood than before treatment being pumped through the organ at each contraction as is shown by the increased volume of the pulse. The beat is also increased in frequency.

The Pulse.—The rate is accelerated from thirty to fifty beats per minute, and the volume exhibits marked increase. If it was weak before treatment it becomes strong during administration. If the application is continued too long it loses its volume and strength, becoming rapid, small, and soft; under these conditions the patient becomes faint, dizzy and nauseated.

The Blood Pressure.—The effect upon arterial tension is interesting. At first thought it would be conjectured that increasing the rapidity and strength of the heart action would also increase arterial tension, and this conjecture has led to the belief in many quarters that it was unsafe to apply the body dry hot air treatment in cases exhibiting abnormally high blood pressure, more especially arterio-sclerosis and cerebral hemorrhage. Now, there is no measure with which I have had any experience that can vie with the body dry hot air treatment in removing arterio-sclerosis and its evil results, hence it was of some importance to determine this point definitely. We therefore conducted observations on the arterial tension, before treatment and after treatment, in one hundred and eighty-six applications on different patients. These observations were made with a Cook's modification of the Riva Rocci sphygmomanometer, the same instrument

being applied in the same way for all observations. The average of the blood pressures taken before treatment was 120 millimeters; after treatment it was 118 millimeters. The average effect upon the blood pressure, then, is negligible, though such as is manifest is in the line of a *reduction of tension.*

I may say in passing that these observations on the influence of the measure on blood pressure agree substantially with observations made by Bain, Edgecombe, Franklin (London Lancet, April 29, 1905), Herrick (Archives of Physiological Therapy, Vol. II, No. 5) and others.

Analysis of these observations shows that, as a rule, in cases presenting an abnormally high arterial tension, such as cardio-vascular-renal disease for instance, this symptom is markedly lessened during treatment, returning nearly or completely to the level obtaining before treatment after the effect of the application has passed off. A *course* of treatments will frequently produce a permanent lowering of tension.

This remedial measure would seem, then, to be logically indicated (instead of contra-indicated) in cerebral hemorrhage, arterio-sclerosis and other conditions in connection with which it is desirable to lessen vascular tension, and our clinical experience tends to validate this conclusion. It has become our favorite method of combating such conditions.

The Capillary Circulation.—The capillary areas become injected, but this phenomenon is not as marked in the regions actually in contact with the heat as is the case with the local treatment. The fact that the capillaries of the face, which is never subjected to the heat, share this general distention even when constantly under the influence of the breeze from an electric fan, demonstrates that the influence is essentially reflex in character and that it is profound.

This capacity to "flush" the general capillary areas would suggest that the body dry hot air treatment would also be indicated in pathological conditions characterized by local circulatory stasis (as local septic infection), in connection with which it is desirable to activate the blood and lymph streams whereby the blood and lymph of the general circulation (which is rich in anti-bacterial bodies and healthy, active phagocytes) may be brought into effective contact with the invading micro-organisms at the site of infection, and these micro-organisms together with their toxins, in turn, carried into the general circulation, where, by auto-inoculation, the opsonic index of the blood may be raised for those particular bacteria which it is desired to eliminate in the individual case under treatment (see "Studies on Immunization", Sir A. O. Wright). Clinical experience also demonstrates the validity of this deduction as will be seen in the chapter on local septic infection.

Composition of the Blood.—The number of white corpuscles is increased in different cases from fifteen to fifty per cent.

The red blood cells are increased from ten to twenty per cent.

These modifications are probably due, in part at least, to the fact that this therapeutical measure brings the blood from the deeper parts of the body to the surface where it is accessible for examination, the blood from the deeply located vessels being richer in corpuscles than that from the undilated capillaries in the skin.

Viscosity.—R. Burton-Opie (Journal of Experimental Medicine), has made a number of interesting experiments on dogs with a view to ascertaining whether or not changes in the temperature of the medium surrounding the animal would affect the viscosity of the blood. He investigated the effects of warm and cold water baths and of dry hot air baths.

He found that the viscosity of the blood reacted very sharply toward changes in the temperature of the water baths, it being decreased by warm and increased by cold. The greatest change took place during the first ten or fifteen minutes of the bath and the effects were equally pronounced in the case of either cold or hot water.

The specific gravity of the blood pursued a course parallel to that noted for the viscosity, warm water baths producing a decrease and cold water baths an increase in the specific gravity, the changes being very pronounced in both cases.

The dry hot air bath was found to increase the viscosity of the blood. It is interesting to note that its effects in this connection were directly the reverse of those produced by *warm water baths.* The specific gravity of the blood also became greater during the dry hot air baths and there seemed to be a direct relationship between the modification of the specific gravity and that of the viscosity.

The Sweat Glands.—These organs functionate copiously, the excretion sometimes amounting to several pounds (from one to five) during treatment. If dropsy is present the excretion may be much greater.

The Respiration.—The breathing deepens and the rate increases from five to ten cycles per minute. This modification of function is not accompanied by any sensation of oppression on the part of the patient, however; rather the reverse, in fact.

The Body Temperature.—The mouth temperature rises from one to five degrees Fahrenheit, according to the length and intensity of the application and the susceptibility to stimulation of the individual patient's nerve centers.

The Urine.—The quantity passed in the twenty-four hours succeeding the treatment is usually increased from

twenty-five to one hundred per cent. over that passed during the twenty-four hours preceding.

The quantity of urea excreted in the twenty-four hours succeeding the treatment is also usually increased from fifteen to sixty per cent. over that excreted during the twenty-four hours previous.

Variations in Extent of Influence Induced.

The degrees in which these several phenomena are found to be induced differ widely in different cases, and at present it is not possible to define positively the reasons for the variation or the conditions under which it may be expected to appear. A general rule which seems to apply fairly constantly, however, is that the greater the departure from the normal in a direction the reverse of that in which tends the influence of the dry hot air treatment, the more pronounced will be the effect of the treatment in the directions indicated above. For instance, in pathological conditions characterized by a deficient excretion of urine or urea, the increase in the excretion of these compounds may be expected to be pronounced; in cases exhibiting a marked hyperleucocytosis, on the other hand, only a slight increase in the number of leucocytes, sometimes none at all and again an actual decrease, may be observed, especially if the pathological process which is responsible for the excessive formation of white corpuscles is gotten under immediate control. In healthy individuals who exhibit no departure from the normal, only slight modification may be expected in most cases; nearly always some is observable, however, in the directions noted above.

Subjective Phenomena.

The sensation is rarely disagreeable to the patient, but quite the reverse usually. A pleasant languor is pro-

duced after about ten minutes, which lasts for an hour or two; after the treatment the patient usually becomes drowsy and sleeps. If the application is continued too long the languor gives place to exhaustion, sometimes accompanied by cardiac palpitation and oppressed breathing which may persist for hours. A sense of exhilaration and increased vitality follows the treatment when well administered.

Rationale of Action.

Through the elevation of the temperature of the body *en masse,* and the profound reflex stimulation of the deep nerve centers, are secured, first, a more rapid and complete oxidation of effete materials which are clogging metabolic processes, figuratively speaking, into normal excretory products—urea for the kidneys, CO_2 for the lungs, etc.—which are then easily disposed of by the appropriate organs.

Second, increasing the strength of the cardiac impulse and dilating the capillary areas effects a profound activation of the blood and lymph streams whereby inflammatory stasis is relieved. The highly bactericidal blood from the general circulation is thus "flushed" through the capillaries of tissues which may have sustained infectious invasion and brought into effectively destructive contact with the invading micro-organisms.

Third, a certain number of these organisms, together with their resultant toxins, are carried into the general circulation and an auto-inoculation effected *with vaccines produced by the very micro-organisms which it is desired to destroy.* The vaccine formula, therefore, must necessarily be the absolutely correct one and not subject to the errors and deficiencies of a vaccine made from specimens of infectious material which may or may not represent the correct proportions in which the invading

organisms are combined in the production of the toxæmic mischief which it is desired to overcome in the individual case.

Fourth, the profuse perspiration also probably carries out with it a certain amount of any toxins that may be present in the circulation and this assists in relieving toxæmic depression of nerve centers.

Obviously its field of usefulness extends within limits of considerable magnitude.

It will be observed that the direct physiological influences of this measure are obtained predominantly by reflex action through the sympathetic and spinal nerve centers, the area of skin treated being so great that the capillary circulation is able to dissipate the heat before it penetrates deeply enough to exert its inherent effects directly upon the underlying structures to any great extent.

Reactionary Phenomena.

Although the functional activity of every organ and tissue in the body is immediately and profoundly augmented, yet this exaltation of function is not followed by a reactionary debility if good judgment and proper technique have controlled the administration. Patients usually continue to improve in health and strength for weeks after a course of body dry hot air treatments.

LOCAL APPLICATION.

This therapeutical measure affects physiological function in three ways: first, by a direct stimulation of cell metabolism in the part treated, due to the raising of its temperature *en masse;* second, by reflex acceleration of cell nutrition and function set up by the irritant influence of the heat upon the numerous nerve endings in the skin; and third, by increasing the blood supply to the

part under treatment through reflex dilatation of the capillary areas.

Temperature Elevation of Part Treated.—It is, of course, not possible to raise the temperature, *en masse,* of one portion of the body very much higher than that of the rest of the organism, but by placing the bulb of a clinical thermometer at the bottom of a deep sinus and then applying a local dry hot air treatment it has been demonstrated that an increase of about twelve degrees Fahrenheit can be induced. This is enough to accelerate oxidation processes very perceptibly.

Reflex Effects.—Through the reflex influence is obtained an emphatic local hyperæmia which, together with the reflex stimulation of the trophic nerve supply of the part treated, results in greatly accelerated local metabolism.

In diseases characterized by the presence of pathogenic micro-organisms in the part treated, as local septic infection or peritonitis, this "flushing" of the capillaries brings the bactericidal blood from the general circulation into effective therapeutic contact with the invading micro-organisms. Relief of circulatory stasis also washes into the general circulation a certain proportion of the infecting bacteria with the toxins emanating from them, thereby effecting some degree of anti-inoculation with the specific vaccines appropriate to the individual infection under treatment. If the general toxæmic mischief has not progressed too far the clinical confirmation of the conclusions deducible from these physiological effects is extremely satisfactory.

It has been suggested that the germs in such cases were directly destroyed by the heat, but this view is improbable. There is no experimental or clinical evidence available which can be looked upon as indicating that it is possible to raise the temperature of any portion of the body sufficiently high to render such a result attainable.

Copious perspiration appears upon the region treated and in greater or less degree upon the rest of the body. This secretion is strongly impregnated with fatty acids, whatever the disease from which the patient is suffering, or even if he has no disease at all. If a toxin is being elaborated in the part treated a large proportion of it is thus eliminated before it enters the general blood current, and that which has already entered the circulation is eliminated in direct proportion as the perspiration induced upon the general body surface is profuse.

That local dry hot air applications are sometimes capable of exerting profound reflex influence upon parts physiologically related to but actually distant from the field of direct administration, was demonstrated in a case reported by Walsh. The patient had eczema of both hands; one only was treated, yet both got well. Cases also have been reported where pains in a limb on one side of the body have been relieved while the corresponding limb on the opposite side was being treated.

General Body Temperature and Pulse.—These are rarely much modified by the local application. Patients will sometimes exhibit an increase of a fraction of a degree in the former or an acceleration amounting to eight or ten beats per minute in the latter; modification to these extents is, of course, not capable of influencing the general metabolic functions markedly.

Sphere of Action.

The influence of the local application, then, is practically confined to the part treated. What effects are produced upon the organism as a whole are principally secondary to changes induced in the local disease focus, hence it will not and should not be expected to cure, unaided, pathology of general or central primary causa-

tion. For instance, local treatments alone will not cure the joint lesions of arthritis deformans because these lesions are but secondary manifestations of a general systemic toxæmia or impaired general trophic functions; they will in some instances relieve the pain temporarily, however. In early, localized septic infection, on the other hand, the primary pathological focus is in the part affected, and local dry hot air treatments will usually produce a rapid and radical cure; the organism at large will be secondarily benefited during the curative process, by the lessening of pain depression and of the quantity and virulence of the toxins elaborated in the original pathological focus, in direct proportion as the local lesion improves.

SUMMARY OF PHYSIOLOGICAL INFLUENCES.

General Application.—First, an immediate and powerful stimulation of the vital physical functions which is evidenced, before the patient leaves the apparatus, by augmented vigor of the heart action and increased volume of the peripheral circulation.

Second, a reflex stimulation of the functions of all the organs and tissues of the body which results in *(a)* a degree of elimination of toxæmia and katabolic excreta probably unequaled by that producible with any other measure now known; and *(b)* an amount of general reconstructive activity which would also seem to be in excess of that derivable from the use of other agents.

Third, a dilatation of the peripheral circulation which results in a degree of capillary "flushing" and blood and lymph stream activation unequaled by that producible with any other measure now known.

Local Application.—First, dilatation of peripheral circulation and activation of the blood and lymph streams in the part treated.

Second, acceleration of the nutritive processes of the part due to reflex stimulation of the tropic nerve supply through thermic irritation of the nerve endings in the skin.

Third, an increase in the temperature of the part treated whereby the chemical reactions constituting local metabolism are facilitated.

Fourth, the withdrawal of a large amount of fluid from the part treated by reason of the profuse perspiration induced.

CLINICAL APPLICABILITY.

It will be seen from the foregoing that the conditions to which thermaerotherapy is applicable naturally group themselves into three classes.

First, those in which the essential primary pathology is strictly local and amenable to an increase in the local nutritional, absorptive, eliminative and bactericidal functions, and for the management of which the local application is sufficient. As illustrations may be mentioned sprains, local septic infection of the limbs in the early stages, and many cases of rheumatism.

Second, cases in which the essential primary pathology is strictly local and amenable as above, but in which resultant conditions in the organism at large have extended the original symptom complex, as, for instance, in local septic infection with profound systemic toxæmia. It is usually necessary to invoke the more profound influences upon the body functions of the general dry hot air application for the successful management of this class of cases.

Third, the general constitutional and diathetic diseases in which only the profoundly acting reflex influences of the body treatment upon the general metabolic functions are of benefit. In this category are gout, Bright's disease of the kidneys and arthritis deformans.

ANALOGIES.

It will be observed that the physiological action of dry hot air is made up of most of the integral elements which combine to form the physiological actions of the various hydrotherapeutic procedures, electricity, mechanical vibratory stimulation, massage, etc., but that such elements as are common vary in the proportion of intensity with which they manifest themselves in the characteristic influences of these different remedial measures; hence, in some directions dry hot air is more efficient than any of them. It is frequently advantageous, however, and as will be seen later sometimes necessary, to combine other elements of therapeusis, physiological, medicinal, and surgical, with dry hot air in order to accomplish certain results. None of them alone will do the work of several combined in many cases.

The mode of action of thermaerotherapeutical influences is also directly parallel with and immediately in the line of the normal physiological activities concerned in cell development and tissue reconstruction, hence the only pernicious after-effect to be guarded against is reaction from over-stimulation, the avoidance of which will be discussed in the succeeding chapter.

FALLACIES.

As to Identity of the Influences Exerted by Hot and Cold Applications.—A belief is more or less current that the effects upon physiological function of degrees of heat and cold which depart from the normal body temperature to the same extent in their respective directions, are identical. This belief is based upon a conception of the physiological actions of such applications, which assumes that *undifferentiated irritation of nerve endings in the skin* constitutes the only factor involved.

If such were the case the above-mentioned belief

would undoubtedly be true, but reflection shows the problem to be much more complicated. The gross physiological effects of either hot or cold applications are made up of at least three component influences; first, that obtaining through modifications of sensation (including psychic impressions); second, that obtaining through the reflexes; and third, that dependent upon the *direct, inherent, physical and chemical* results of heating or chilling body tissues. The gross physiological influence being a composite phenomenon therefore, the operation of factors that alter the nature of any of the elemental constituent influences, or change the proportionate prominence with which they enter into the combination, would necessarily modify the physiological result.

To convince oneself that a radical difference obtains as regards *sensation,* it is only necessary to immerse the hand or foot in water at 73° F., and after the member has fully recovered immerse it in water at 123° F. (nearly the extreme limit of temperature elevation at which contact with water can be tolerated), which is as much hotter than the normal as the former is colder; if the immersion is not maintained long enough to obtund sensibility the deduction will offer no difficulties.

Another discrepancy, suggested by the preceding paragraph, is that contact with water can be tolerated at a much greater departure from the normal body temperature, in the direction of cold than of heat; more than twice as great with the majority of individuals. This discrepancy involves not only sensation, but the actual physical, structural integrity of the tissues subjected to influence.

To demonstrate a substantial difference in *reflex* effects, immerse the feet of a person who is perspiring freely in water at 73° F. for a few seconds and note what a

lessening in the emunctory process takes place; conversely, immerse the feet of a person who is not perspiring, in water at 123° F. and see the perspiration start.

A disparity in the *direct inherent, physical* effects produced by actually chilling or heating body tissues, becomes at once apparent to anyone who has observed the different manner in which an incarcerated hernia responds to the two applications. Such a disparity is also well illustrated by the fact that superficial neuralgias and other painful conditions are sometimes relieved by hot compresses and aggravated by cold, and *vice versa.*

Nothing conclusive can be said as to the prominence of the first-mentioned factor as a modifying element; it has not yet been determined in just what degree or manner differences in sensation are active in influencing physiological function. We *do* know, however, that a remedial measure that is not unpleasant to the patient is likely to produce better results than one which *is* unpleasant, and the application of which is therefore anticipated by him with dread. The therapeutical application of dry hot air is very rarely unpleasant in the slightest degree, that of cold is not infrequently fraught with torture both mental and physical; patients usually look forward with pleasure to the former, and frequently with terror to the latter.

As regards the reflex tendencies of cold and heat, it is reasonable to infer from oft-observed clinical and experimental findings, that they are exerted in the *same directions* as are the direct and inherent effects; i. e., an application of cold would tend *primarily* to affect the metabolism and nervous phenomena of the area influenced as would cold if applied directly and long enough to chill the parts; an application of heat would tend *primarily* to affect the area influenced as would an actual raising of its temperature *en masse.*

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The proposition stated in the foregoing paragraph assumes that neither the heat or the cold is applied with sufficient intensity to excite protest from the tissues under influence. The production of protest would introduce the elements of *irritation and reaction* into the equation, and these are discussed in a later paragraph.

The direct, inherent, physical effects of cold and heat may be indicated as follows:

First, chilling a body tends to *check* chemical changes going on among its component atoms; as applied to the human body the direct inherent effect would be to *hinder* metabolism, which involves cell and tissue reconstruction as well as destruction or waste.

Second, heating a body, on the contrary, tends to *facilitate* chemical changes going on among its component atoms; as applied to the human body the direct and inherent tendency would be to *accelerate* metabolism, which, again, involves cell and tissue reconstruction as well as destruction or waste.

Applying these principles practically, then, we find that the application of cold to the body brings into play a force which is antagonistic to normal metabolism and catabolism, nervous and glandular function, as represented by chemical change and the facility with which nerve impulses are transmitted. If the application is sufficiently intense, the organism will resist at the first impact; if contact is prolonged sufficiently to overcome this initial resistance, metabolic processes will be retarded in direct proportion as the tissues are chilled. After the inhibitory effect has passed away, the organism will endeavor to overcome or make up for the effects of temporary suspension of vital processes by temporarily increasing normal processes and functions; by manifesting *reaction.*

The stimulant influence of cold, then, is constituted

solely and entirely by this tendency toward resistance and reaction, hence the *degree* of stimulation obtainable with it is limited absolutely by the vitality, or power to resist such antagonistic influences, of the organism under treatment. If the organism is so weakened by disease or any other factor as to be unable to resist with a requisite degree of vigor, depression instead of stimulation will result.

The application of heat to the body, on the other hand, brings into play a force and induces conditions which are entirely in harmony with the normal processes, hence there will be no initial resistance and no temporary paralysis of metabolism which must be overcome before stimulation (reaction) sets in. Its influence, being inherently in harmony with normal metabolism, is accelerant to these processes, in some degree, from the start and continues so to be throughout every phase of action contingent upon its sustained application.

When we recall that in the great majority of pathological conditions the human organism endeavors to rid itself of disability solely and entirely through accentuation of the normal metabolic processes, the deduction as to the relative applicabilities of cold and heat to such pathological conditions becomes immediately apparent.

Another important fact exhibiting a prominent therapeutical bearing and contingent upon the foregoing, is that cold is directly, inherently, and reflexly *inhibitive to elimination* as well as cell production and increases the former function only secondarily through the reaction obtainable, and that heat, on the contrary, is directly inherently, and reflexly *accelerant* to elimination, primarily and throughout the whole period during which it may be applied.

The element most active in producing the immediate,

visible *stimulation* of the vital signs obtainable with dry hot air, however, to apply the foregoing directly to our immediate subject, is irritation of the nerve-endings in the skin when the heat has become intense enough to excite protest (reaction) from the deep nerve centers. This protest, however, is not against an inherently antagonistic force which threatens inhibition and it has not been necessary to paralyze normal processes in order to elicit the reaction, hence it would be expected to act more kindly than cold. Further, this irritation of nerve-endings occurs late in the application and after the organism has been so influenced through acceleration of its vital processes as to be capable of more efficient reaction, as suggested in the preceding paragraphs; the gross stimulation obtainable with this agent therefore is much more profound than when cold is employed.

The inference, then, that the gross effects of cold and hot applications are identical is not demonstrable by experiment, confirmable by clinical experience, or defensible by any line of logic based upon observed physical or physiological facts. We are justified therefore in making the claim, suggested by practical experience, that radical differences exist and that they demonstrate that dry hot air has a place in the treatment of disease that no other known measure can fill; that to secure the best therapeutical results these differences must be recognized, distinguished, and thoughtfully considered in connection with the management of different disease processes.

As to Identity of the Effects Producible with Dry Hot Air and Hydrotherapy.—The hydriatic modalities depend for the induction of their various influences upon the bringing into contact with the skin of different degrees of heat and cold through the medium of water variously manipulated. As far as the inherent effects of

heat and cold are involved in hydrotherapeutic applications, all that has been said in the preceding section applies equally well here, but, as has previously been stated, hydriatic and dry hot air applications are not directly comparable because practical difficulties render it impossible to apply the same degrees of treatment intensity; the conditions surrounding the use of these two remedial measures therefore are not susceptible of identification for purposes of comparison. Further, some hydriatic procedures include *percussion,* an element which has no parallel in any method of dry hot air therapy except the dry hot air douche.

The practical difficulty which obtains in those hydrotherapeutical procedures involving heat consists of the fact that nothing like the same degree of treatment intensity can be applied to the skin through the medium of water as through the medium of air, because the structural integrity of this tissue is seriously endangered when the temperature of a wet application approaches 170° F., and the result of contact at 212° F. needs only to be mentioned to be appreciated. Air can safely be applied to the skin at 400° F. and sometimes more if proper precautions are observed, and its characteristic and most desirable effects are not produced at a temperature lower than 300° F.

As regards comparison of the effects of general cool and cold hydriatic applications and dry hot air, to the whole or the greater part of the body surface, no one who has ever contrasted the appearance of a typhoid patient, shivering, cyanosed, and with weakened pulse after a bath only fifteen or twenty degrees Fahrenheit below the body temperature, with that of such a patient who has been given a body dry hot air treatment, will any longer entertain doubt as to the existence of a radical difference in the gross effect of the two measures. The

general dry hot air application never produces shivering or cyanosis, with all that they imply, no matter whether it is administered at ten or three hundred degrees above the normal body temperature; on the contrary, the sedative influence upon the nervous system is invariably marked, the patient usually falling into a quiet sleep within two hours, and the ruddy glow of the skin, warmth of the extremities, and augmented volume and force of the pulse which ensue demonstrate that a direct and powerful sedative and tonic force has been at work.

The elucidation of the variation in these two pictures is found in the fact that the patient who is cyanosed and responding badly to the cold bath has not sufficient vitality to react adequately, while the influence and effect of the general dry hot air treatment are such that much less reactive power on the part of the patient is necessary for the production of its full effect; the thermal agent furnishes inherently and directly the greater part of the effect demanded.

No matter how carefully and conscientiously the hydrotherapeutic treatment of typhoid fever is carried out the above described picture not infrequently obtains, and we have seen profound and alarming prostration following twenty minutes of simple cold toweling of a patient in bed and which refused to yield to strychnia hypodermically, whiskey, and vigorous rubbing, overcome at once by fifteen minutes of general dry hot air at 300° F.; a very good practical indication that the measures exert radically different influences. In addition to this, typhoid patients sometimes complain bitterly of the hydriatic application, but I have never heard one object at all strenuously to the general dry hot air treatment; on the contrary, they usually like and feel comforted by it.

After what has been said in this and the preceding sections, a statement, which has been published, to the effect

that dry hot air applications are "not complete except when systematically employed in conjunction with hydrotherapy," will need but brief discussion.

The profundity and intensity characterizing the acceleration of functional and general metabolic processes, evoked by a thoroughly administered dry hot air treatment, is limited only by the inherent capacity of the organism under influence for carrying on these processes; hence they could not be further increased by the application of any other force acting from without the organism, and certainly not by a force which depended for its stimulating properties upon the reactive capacity of such organism. If the dry hot air were not intelligently and thoroughly administered (as when the degree of heat employed is not sufficiently intense, etc.) and if the patient's reactive powers were adequate it would be obvious that the application of an additional stimulant would be beneficial; when shortcomings in technique are eliminated, however, dry hot air rarely, if ever, needs to be followed by hydrotherapy in order that its beneficent work may be complete.

This does not mean, however, that hydrotherapy is not of value, and of great value, when combined (alternated) with dry hot air applications; on the contrary, in some conditions such employment of hydriatic measures is of the greatest assistance.

As to Permanence of Results.—One commonly hears it stated that the curative results obtainable by the use of dry hot air are not permanent. This criticism is largely based upon the belief that dry hot air is only a palliative measure, like a dose of morphine in painful conditions, for instance, and would never be entertained if the profound influences upon physiological function which we have been discussing were given due consideration. The belief was originally given weight by the observation

that cases of rheumatism treated with dry hot air *alone* very frequently "came back," but this merely meant that the disease was not cured because the thermal agent was not properly supported by the simultaneous administration of appropriate drugs in appropriate dosage. The therapeutical characteristics exhibited by dry hot air consist in its power to accomplish, either alone or in combination with other indicated agents, that which it is impossible for any other combination of agents to accomplish without its aid.

Another fact bearing upon this criticism is that when we have carried a patient through an attack of pneumonia, typhoid, rheumatism, or any other disease, except where the ætiological factor has been removed surgically, we cannot assure him that he will never have the disease again, no matter what curative agents we have employed. We can only be certain that this one attack has been extinguished. If appropriate environmental and constitutional conditions again obtain he will surely have to sustain another attack, no matter how perfect may have been his health in the meantime. When men no longer contend with conditions which engender habits of life that are inconsistent with their perfect physical health, then, and not till then, shall we be immune from repeated attacks of disease, and when that millennium has arrived, dry hot air and most of our other remedial agents will have retired to the oblivion of complete desuetude.

In closing the consideration of this division of our subject I desire to emphasize the fact that the key to the attainment of satisfactory results by the use of dry hot air as a therapeutic agent is the same as with any other remedial measure, medicinal or otherwise, viz., a thorough knowledge of the physiological action of the agent, and a logical consideration of the same with reference to the pathology of the individual departure from the normal for which a remedy is being sought.

CHAPTER III.

TECHNIQUE.

The difference between proper, thorough technique and the reverse, frequently constitutes the difference between success and failure in clinical results; hence this subject is a very important one and merits close study.

The current idea that it is a perfectly easy matter for *any* physician to secure a dry hot air apparatus and successfully treat his patient without any special knowledge of the agent or the management of it with reference to different pathological conditions, is entirely erroneous and much to be deplored. When this unfortunate impression has been eliminated better results may be looked for from its general employment, and appreciation of its beneficent powers will succeed the lack of confidence with which it is so frequently regarded at present. Inefficient technique, and lack of adequate familiarity with its physiological action and clinical possibilities, whereby it has been called upon to produce results which a reasonable degree of enlightenment upon these points would have taught should never have been expected of it, have brought upon dry hot air a vast deal of undeserved opprobrium.

METHODS OF PREPARATION.

There are two ways of giving treatments; with coverings and without.

The latter method is based upon the assumption that the perspiration will be evaporated off from the skin by the high degree of heat as soon as it is formed. While this should perhaps be so theoretically, yet experience

demonstrates that it does not always take place. A large proportion of the perspiration *does* evaporate immediately, and if a low degree of heat (200° to 250° F.) is used, the administration without coverings is very satisfactory. But it is ordinarily necessary to employ greater intensities (350° to 450° F.) and then the sweat-glands functionate so copiously that the secretion is not all vaporized immediately and the residue becomes hot enough to blister.

Employment of the covering obviates this danger. As it invests the skin closely the perspiration is absorbed by it as fast as it collects and the attenuation of the secretion effected by distributing it through the meshes of the fabric facilitates its conversion into steam by the heat, when it readily diffuses off into the air surrounding the part under treatment.

The material for the covering should be loose-meshed and as absorbent as possible, and the cheap grades of Turkish toweling have given us greater satisfaction than anything else.

It has been urged as an objection against the use of wrappings, that the heat would be dissipated by its passage through them to such an extent that although the treatment could be applied at a much higher temperature than when they were not used, yet the layers of air in immediate contact with the skin would not exhibit a temperature in excess of that which it would be possible to apply if the application were made to the bare skin. To dispose of the point it is only necessary to insert a high temperature thermometer between the layers of the wrapping during a treatment, remove it quickly, and note the reading. Again, anyone who has observed the methods when given side by side cannot fail to be impressed by the variation obtaining, both as regards therapeutical influence and the comfort of the patient.

LOCAL APPLICATION.

Preparation.

It is well to have the patient remove all of his clothing and don a flannelette robe or suit of pajamas in which to undergo this treatment; he is thereby enabled to go home in dry garments instead of those which have been dampened by perspiration.

Arms and Legs.—For treating these members and portions thereof the Turkish toweling should be cut into strips about seven inches wide and five feet long, hemmed and rolled like a surgical bandage. It is applied the same as a roller bandage (Cut XII), not tightly, but closely enough to obtain even and intimate contact between it and the skin.

There should then be wound about it, paying especial attention to the creases and recesses, a line of tape with the turns about one inch apart (Cuts XIII and XIV); this will press the toweling down upon the skin where the original application of the wrapping has failed to do so, making the contact as perfect as possible.

The limb is then ready to be placed in the apparatus, after which *it should be again carefully inspected to see that everything is in proper position before the heat is turned on.*

Knee.—At first sight the apparatus designed especially for treating this joint would seem to be particularly well adapted for its purpose, but when it is attempted to utilize it practical difficulties present themselves.

In this machine the leg is supported by a canvas or denim strip passing from side to side in the interior of the hot air reservoir, upon which it is designed that the posterior surface of the joint shall rest. It will be found that when the perspiration starts it will run down and soak into the wrapping next to the popliteal space, and

will be confined there by the pressure of the canvas strip under the weight of the leg. Instead of being rapidly diffused off into the air in the cylinder it remains in contact with the skin, and the constant steaming produced will render it impossible to secure the desired intensity of heat without blistering.

It was attempted to obviate the difficulty by having two vertical supports made, one to be placed at the distal and the other at the proximal end of the apparatus and entirely external to it, upon which the leg should rest. By this means it was possible to do away with the supporting strip inside of the reservoir and the conditions were considerably improved; blistering was still uncomfortably frequent, however. Finally, the special knee apparatus was discarded altogether and the general local machine substituted with eminently satisfactory results; much better in fact than those obtained with the one especially designed for the joint (Cuts XIV and XV).

Other advantages dependent upon treating the whole of the limb below the knee as well as the joint itself, are, first, the greater amount of reflex trophic influence obtained by reason of the greater area of skin exposed, whereby the total number of nerve-endings stimulated is increased two to three-fold; and second, the greater rise of temperature producible in the tissues about the joint, hence greater acceleration of metabolism, through the heating of the entire return circulation from the toes upward.

Knee joints which it is desired to treat with dry hot air, however, are sometimes ankylosed in the flexed position, which renders it impossible to get the joint into the general local apparatus; that specially designed for the knee then becomes the only one available.

The joint is wrapped with three thicknesses of Turkish toweling strips for a distance of ten inches above the

XII.—Applying Turkish-Toweling Strips Preparatory to Local Application of Dry Hot Air to Knee with Special Knee Apparatus.

XIII.—Patient Prepared for Local Application of Dry Hot Air to Knee with Special Knee Apparatus.

XIV.—Patient Prepared for Local Application of Dry Hot Air to Leg from Knee Downward.

XV.—Local Application of Dry Hot Air to Leg from Knee Downward with Betz General Local Apparatus.

XVI.—Local Application of Dry Hot Air to Knee with Betz Special Knee Apparatus.

patella and for the same distance below this point (Cut XIII). The foot is then carried through the cylinder until the knee joint is directly above the source of heat and resting upon the hammock. The flexible attachment for closing the distal end is fastened about the limb six or eight inches below the knee and that for the proximal end at the same distance about (Cut XVI). The heat is then turned on and run up as high as the patient's tolerance will permit, but for the reasons just stated this will rarely be more than 275° F.; this degree of heat is much less efficient than 350° F. and not infrequently it will fail altogether in producing the desired therapeutical result.

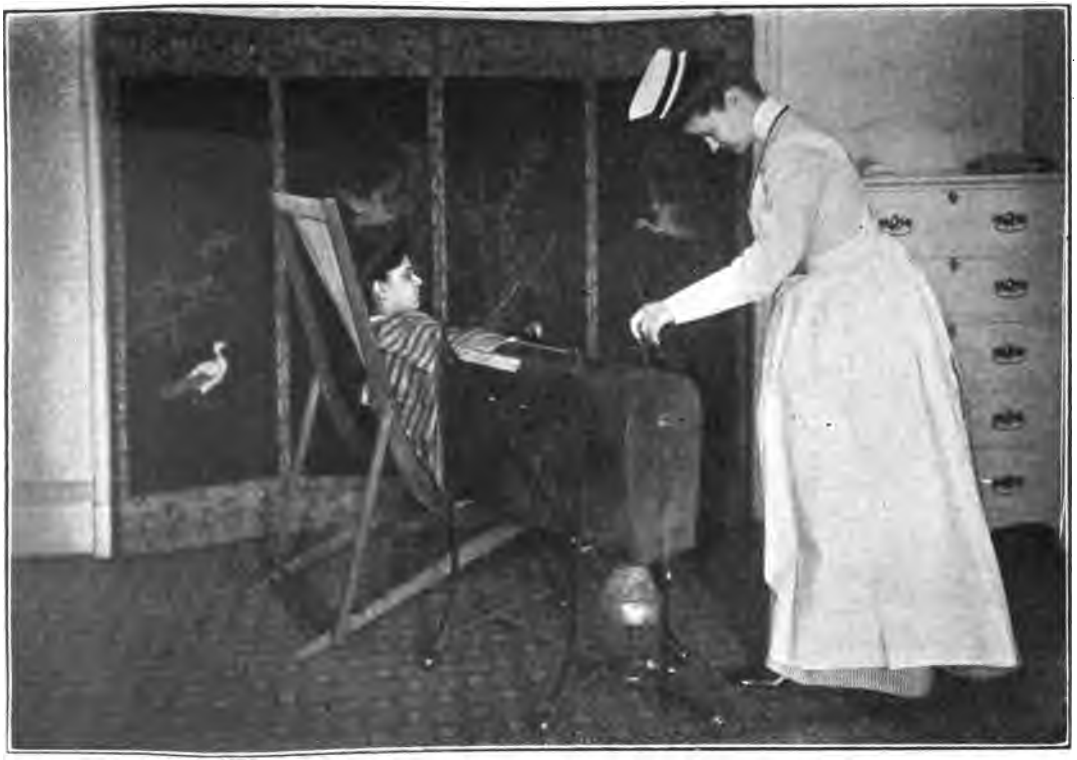
The fact that an efficient special knee apparatus is not at present available, however, is not of as much importance as would at first be supposed. The class of arthritic affections in which the general local apparatus cannot be used for treating this joint is, as will be seen later, that in which local repair is best obtained through restorative influence exerted upon the general system, and the body treatment renders the use of local applications unnecessary.

Shoulder.—When the shoulder, hip, abdomen, lung or lumbar region is to constitute the field of operation the toweling should be cut in pieces eighteen or twenty inches wide and five feet long; when folded twice so as to make three thicknesses such a piece presents an area that is very convenient for use in these situations. It is also well to have on hand three or four pieces of toweling about eighteen inches square for use with those patients who require but a single thickness of the wrappings.

When adjusting the wrapping to this region it will be found advantageous to locate it diagonally with a corner pointed down the arm (Cuts XVII and XVIII) and to commence the winding of the retaining tape at the lower end.

XVII.—Position of Covering Preparatory to Adjustment for Local Dry Hot Air Application to Shoulder.

XVIII.—Shoulder Prepared for Local Dry Hot Air Application.



XIX.—Local Dry Hot Air Application to Shoulder.

Although tape does very well for retaining the wrapping in this location, yet it will be found that cloth straps one inch wide, furnished with a buckle at one end, and about five feet long, will be found more satisfactory in most cases. After the wrapping has been located as above, such a strap is passed around the body immediately below the armpits so as to include that portion of the wrapping which is folded under the axilla, and buckled so that the buckle is posterior and opposite the median line of the back between the shoulder blades. The free end of the strap is then brought over the wrapping on the shoulder close to the root of the neck and pinned to that portion of the strap which passes over the sternum. The edges of the wrapping about the upper arm are then drawn together upon the inner side of the arm midway between the axilla and the elbow and pinned together with a safety pin (Cut XVIII). By this means, slight, uniform tension is exerted upon the wrappings all over the area to be treated and in all directions, and no constriction of the blood-vessels or other uncomfortable sensations will annoy the patient.

As with the knee joint a better therapeutic result can be attained if the whole arm as well as the shoulder is subjected to influence and the entire return circulation of the arm heated. When deformities or motile limitation from pain is not present in such a degree as to prevent carrying the arm away from the body so as to get it into the cylinder therefore, the wrappings used should consist of the strips and their application should commence at the finger tips and be extended to the neck. The proximal end of the cloth attachment should then be adjusted to the patient sufficiently high up to include the shoulder, and the arm rested upon the hammock inside of the apparatus.

The special chair devised by the author and described

in Chapter I will be found very helpful when administering a treatment to the shoulder.

Hip.—The same suggestion as to placing the wrapping applies when the hip is being prepared for treatment, and in this situation also the cloth straps described in connection with preparation of the shoulder will be found better than tape for holding the toweling in place (Cuts XX and XXI).

Treatment is most conveniently administered with the patient lying on his side upon a couch, the hip to be treated being uppermost.

Abdomen.—The patient is brought to the edge of the bed, the wrapping placed upon the abdomen, and retained in place by webbing straps one inch broad, long enough to pass clear around the body, and furnished with a buckle at one end; these are passed about the body one just above another just below the iliac crests.

The patient is then turned upon his side facing outwardly from the bed and a pillow placed under the lumbar region, so as to prevent the sagging of this portion of the body due to the projection of the undermost iliac crest.

When this position has been attained it will be found that the webbing straps will require readjustment in order that good apposition of toweling and skin may be maintained. It will also be found that the sagging of the abdomen due to the position has caused a hollow to form immediately under the uppermost iliac spine, into which the toweling will have to be pressed by crowding a napkin under the retaining strap in this situation (Cuts XXX and XXXI, pp. 238 and 239).

This hollow must be carefully watched during treatment and the covering frequently pressed down upon the skin by the hand of the operator, or blisters will sometimes form in spite of the napkin.

XX.—Hip Prepared for Local Dry Hot Air Application.

XXI.—Local Dry Hot Air Application to Hip.

The Chest Wall and Lumbar Region.—The cloth straps used in the abdominal operation constitute the most efficient means of maintaining the necessary contact between wrapping and skin when treatment is to be applied over the lungs or the lumbar region (Cuts XXII, XXIII and XXIV).

When the chest wall of a woman is to be treated one of the retaining straps should be passed around the body directly under the breast, so as to press the toweling well down into the hollow formed by the projection of this part of her anatomy. It will be wise to press the toweling frequently against the skin in this situation anyway during the séance, as the occasional impossibility of securing close contact here, even with a well applied belt, invites a tendency toward blister formation.

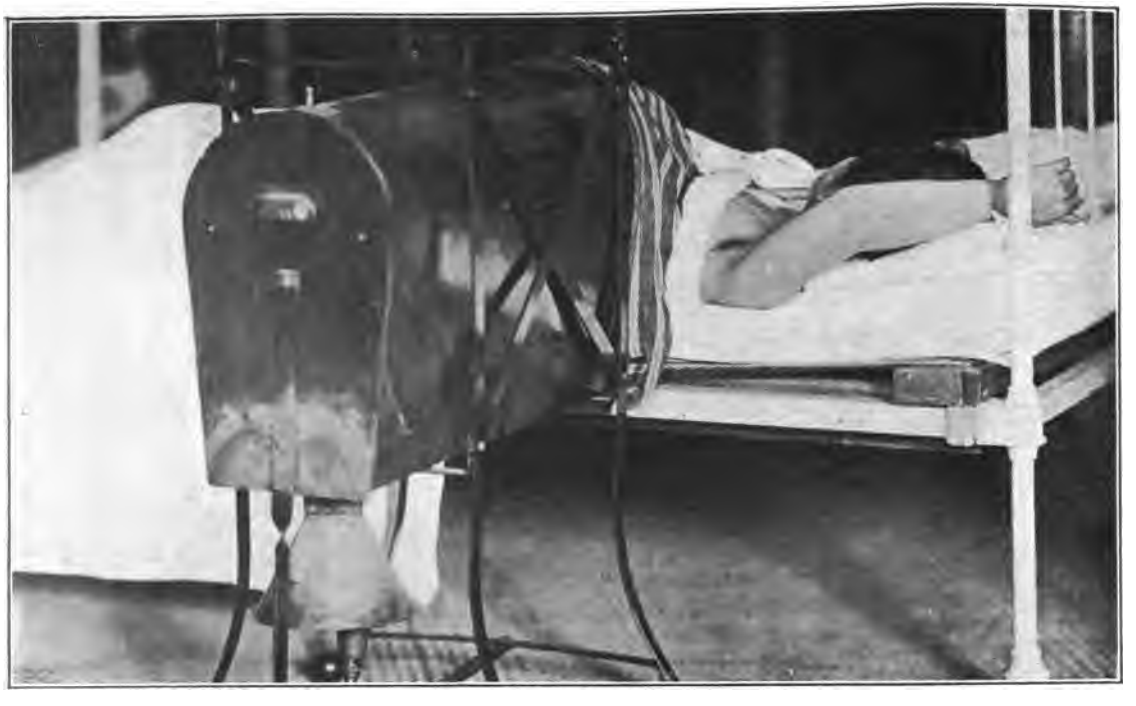
Amount of Wrapping Necessary.—Just the right amount of covering to be employed will be determined by the idiosyncrasy of the individual patient as regards profuseness of perspiration, and of the treatment as regards the intensity of heat, etc., but should be as little as is consistent with safety of the integument. At least one thickness, however, should cover every part of the area exposed, and the wrappings should be boiled in soap and water after each application.

Adjustment of Apparatus.

When the Betz general local apparatus is employed particular care should be exercised to see that the heat carrier entirely covers the hole in the bottom of the cylinder through which the hot air enters, before the treatment is started. It is very liable to become displaced when the machine is moved and when displaced the thermometer reading is absolutely unreliable as an index to treatment intensity; further, the proper distribution of heat to all parts of the apparatus is seriously interfered with by such displacement.

XXII.—Local Dry Hot Air Application to Lumbar and Sacral Regions.

XXIII.—Patient Prepared for Local Dry Hot Air Application to Left Lung or Pleuræ.



XXIV.—Local Application of Dry Hot Air to Left Lung or Pleuræ.

When treating portions of the body other than the extremities, the supporting hammock inside of the apparatus is of no utility and had better be removed from the machine altogether.

Administration.

After the wrappings have been applied the cloth attachment appropriate to the region which is to be treated should be adjusted, *first to the patient* and then to the apparatus, and the heat turned on.

The office of the operator during the treatment resolves itself into four functions, as follows:

First, attaining, and steadily maintaining a temperature in the apparatus, of appropriate elevation.

Second, changing the air in the cylinder often enough to maintain dryness.

Third, guarding against ignition of the wrappings and cloth fittings of the apparatus.

Fourth, preventing blister formation.

Accomplishment of the first involves merely allowing the temperature to rise steadily until the desired intensity is reached, where it may be maintained by regulating the heat supply.

As regards the second, introducing the heated air directly into the cold cylinder will provoke condensation of moisture to such an extent as to necessitate complete ventilation about once every three minutes during the first quarter of an hour. The little valve in the top of the cylinder is not large enough to accomplish this efficiently at this stage of the application and the object is best attained, unless the valve has been enlarged as described in Chapter I, by slipping from the cylinder that portion of the cloth attachment which encircles its upper segment, replacing it again after a few seconds when the air emerges dry. After the machine has become thor-

oughly heated no more inconvenience will be encountered from this source, and opening the valve in the top of the cylinder occasionally for a minute or two will effect all the ventilation necessary.

The best method of accomplishing the third object is to smell occasionally of the air that escapes from the cylinder during ventilation; the odor of scorching cloth will be detectable if danger is imminent.

If the cloth does ignite the first thing to do is to turn off the heat, then remove the patient's limb from the apparatus and dispose of the smouldering fabric. If the mischief is taken in hand as soon as the odor of combustion is detectable there will be ample time in which to eliminate the difficulty before serious results are precipitated.

Attainment of the fourth object will be facilitated if the conditions favoring blister formation are borne in mind, as follows:

First, the presence of an excessive degree of moisture in the air contained in the cylinder.

Second, failure in maintenance of even and intimate contact between covering and skin, due to inefficient application of the wrapping in the first place, or to movements which have caused wrinkles to form on the part of the patient. Perspiration collects upon areas of skin not in contact with the absorbent, and its temperature rapidly rises toward the boiling point.

Third, interference with free circulation of body fluids in the part under treatment, as by undue tightness of the wrappings, sclerotic changes in the vascular structures of the extremities, etc.

Unless some condition of the patient's tissues is present whereby sensibility is obtunded, a threatening blister will cause him to complain of a "burning" sensation; the remedial procedures to be employed when such warning obtains, then, would be as follows:

First, ventilate the cylinder rapidly by separating from it the upper portion of the cloth attachment; if this procedure does not remove the discomfort in a few seconds the first mentioned causative condition is not involved.

Second, introduce the hand into the apparatus and press the toweling down upon the complaining area of skin, when immediate absorption of scalding sweat and relief if the trouble is due to this factor, will follow.

It requires a little practice to execute this maneuver without burning one's hand; the knack consists in getting the hand in on to the part quickly, and quickly out again without touching the sides of the cylinder. It is wise for a beginner to wear a cloth glove during this and the next mentioned procedure; it will save him much discomfort and some blisters of his own.

Third, introduce the hand into the cylinder and loosen the wrappings about the complaining region; if they are too firmly fixed to be susceptible of requisite manipulation in this way, remove the limb from the apparatus and the wrappings from the limb and reapply them more loosely.

When sclerotic changes constitute the offending element soaking the sensitive areas in moderately hot water for ten minutes before treatment, as recommended by Ringer, is the only efficient remedy with which I am acquainted. If this does not obviate the difficulty it will be necessary to treat the patient with a lower degree of heat. Individuals exhibiting gangrenous tendencies cannot safely be subjected to more than 200° F. usually.

Duration and Intensity of Séance.—The local treatment lasts an hour usually; less than this is not enough and more does not increase the effect under ordinary circumstances.

The intensity demanded will vary from 300° to 400° F., rarely more or less.

Both duration and intensity will vary according to the conditions obtaining in the individual case, and will be discussed in their relations to different pathological states in the sections which treat of these states.

After-Care.—Wiping the perspiration from the part treated with a dry towel is all that is required under ordinary circumstances. Wrapping the part in flannel or cotton, as is sometimes recommended, is very rarely called for. Conditions exceptional to these rules will be noted in the sections which treat of the diseases in which they occur.

GENERAL BODY APPLICATION.

Preparation.

A loose bath-robe made of Turkish toweling constitutes the best covering to use during the body treatment.

The patient may assume any position agreeable to him, but as it is necessary that he remain quiet and not move his limbs about during the application, lying upon the back is preferable unless deformities are present which render the position irksome.

Small pillows are placed under the hollow parts of the body so as to give it support without strain.

Boots made of the same material as the robe and coming to the knees are pulled on over the feet; if the hands are to be included in the application they should be encased in mittens of Turkish toweling.

The robe is then pressed down between the legs and arranged so as to hug the skin closely, the patient directed not to move his legs about after this has been done, and enough medium sized Turkish towels spread over the feet, legs and abdomen to form three thicknesses (Cut XXV).

Just the right amount of covering to be used will be

XXV.—Patient Prepared for Body Dry Hot Air Treatment with the Betz Body Apparatus.

determined by the idiosyncrasy of the patient as regards profuseness of perspiration and nervous sensibility, and of the apparatus as regards the degree of heat used in the treatment, etc., but should be as little as is consistent with the safety of the integument. Sometimes the robe alone, which constitutes one thickness, will be sufficient; in other cases it will be necessary to cover a portion only of the body, as the feet, abdomen, or thighs, with the extra towels. The patient's sensations are a pretty safe guide in the matter.

The inside of the apparatus should next be inspected to see that no towel or any inflammable object has dropped into it, the carriage upon which the patient lies rolled into the cylinder, the apparatus closed by dropping the curtain or curtains and tucking them in closely about the patient, and the heat turned on.

Administration.

The body area exposed to the heat should usually be that included between the ankles and a point midway between the umbilicus and the nipple line, but it may be extended so as to embrace the whole body up to the neck. The factor which determines whether or not the whole body up to the neck shall be subjected to influence is the degree of response obtained from the nerve centers during the séance, and this also governs the length and intensity of the application.

Different individuals exhibit different degrees of susceptibility to thermic stimulation and each patient must be handled according to his own law. Observation and experience have shown that this factor is tangibly and conveniently expressed under ordinary circumstances by the degree of acceleration of the pulse and increase in the body temperature which, as we have seen in the preceding chapter, accompany its application. The modifica-

tions in the character of the respiratory function exhibit too much irregularity to be of value as indices of responsiveness to stimulation.

The pulse and temperature then being adopted as guides, it becomes necessary to know the *degree* of acceleration and increase, respectively, which must be attained in order that the amount of deep reflex response which will produce the best results may be known to have been induced, and from a study of over eleven thousand body treatments given under our personal supervision, we have adopted, as a working rule, the plan of treating the patient until his pulse-rate has increased to 120 beats per minute, or his mouth temperature is 2 degrees F. above the normal. One of these modifications will be attained first in one patient and the other in the next perhaps, but the attainment of either one usually means that a sufficient influence has been secured and that the time has come to stop the treatment. This rule is of course subject to modification according to the conditions surrounding the individual case.

The mere induction of perspiration, however profuse, is not an indication that a requisite degree of influence has been secured; comparatively low degrees of heat will often do this. What we want is the *deep reflex response,* hence the necessity for intelligently thorough treatment. Patients not treated up to this point do not get their due in the way of benefit, and if it is carried much farther the nervous system ordinarily shows signs of over-stimulation, which is nearly as bad.

Sometimes the application will be completed in fifteen minutes, sometimes it will require an hour.

When acceleration of pulse and increase of body temperature are already present, as with some acute febrile conditions, this rule, of course, possesses no value and

the general effect upon the patient's nervous system must govern duration and intensity, care being taken not to over-stimulate. *Decided dilatation of the capillaries of the face* is a guide of great value under these conditions, and usually indicates that a sufficient degree of treatment intensity has been reached.

Phenomena sometimes induced during treatment and which demand attention are nausea or retching, faintness, oppression of breathing, headache, cranial throbbing and ringing in the ears. The first three are evidences of hyper-excitability of the nerve centers and are ordinarily met with only in hysterical subjects; the occurrence of the others indicates cerebral congestion and usually means that the limit of treatment duration and intensity, consistent with the patient's best good, has been reached.

The remedy consists of the application of an ice-cap to the patient's head, which, with moderate fanning of the exposed portions of the body, will usually take care of the situation perfectly. If the symptoms persist in spite of these remedies the heat should be turned off, the patient cooled, and at the next séance the temperature should be run up more slowly. I have seen but one patient who could not take the limit if handled well and he was a victim of angina pectoris; the pain was always provoked when the pulse-rate reached 110, but it also always subsided kindly as soon as the heat was turned off and the pulse-rate had lessened.

Water may be given at any time during the treatment in dessertspoonful doses every thirty seconds if the patient develops thirst, but should not be administered in large quantities at once.

Prevention of Accidents.—As regards scalds, burns, etc., the same causative factors, cautions, and means of prevention apply here as were mentioned when ad-

ministration of the local application was considered, and to avoid repetition the reader is referred to that section for this information. If changing the air or pressing the covering against the skin does not relieve the burning sensation, open up the apparatus and spread another towel over the complaining spot. No matter what apparatus is used, if the heat is intense enough blisters are liable to obtain, and constant care should invariably be exercised.

When the toes are included in the treatment area the management of these members sometimes assumes a prominence which renders it worthy of special mention. The first thing to do when a patient complains of discomfort affecting these members is to change the air in the apparatus, which will dispose of whatever steam may have collected, and direct the patient to move his toes gently backward and forward against the wrappings, but without raising his heels or knees from the couch.

If this procedure does not remove the difficulty, open up the apparatus and loosen the wrappings about the suffering members; this measure will always prove effective unless some mechanical interference with the circulation of the parts, such as atheroma, sustains a causative relation.

If the last mentioned causation is responsible, soaking the feet in moderately hot water for ten minutes immediately before treatment will sometimes prevent the annoying sensation.

If it persists in spite of the use of all of these measures, however, it will be necessary to resort to the radical plan of treating the patient with his feet outside of the cylinder entirely, the curtains closing the pedal end being tucked closely about his ankles.

Leaving the feet outside does not detract in the least

from the efficiency of the treatment, even when the disease process is located in these members. As has been stated when considering the physiological action of the body treatment, its influence "is predominantly reflex through the sympathetic and spinal nerve centers", hence the profundity of that influence is directly proportional to the number of nerve endings exposed to the thermal stimulation; the number of those present in the skin of the feet bears such a small proportion to the number present in the skin of the rest of the body that practically it may safely be disregarded in this connection. Clinically I have never been able to perceive that it made any difference whether the feet were inside or outside of the apparatus, except in so far as that it was possible to treat the hyper-sensitive patient with a higher degree of heat when the feet were outside, hence modification of metabolism was more marked.

With patients in whom atheroma is present, and is threatening, or has already eventuated in gangrene, the desirability of preventing the toes from blistering is urgent. Under these conditions any traumatic solution of integrity in threatened tissues is liable to inaugurate the gangrenous process, and my appreciation of that fact has been rendered poignant from having had the misfortune to see it demonstrated in my own practice. A man seventy years old was under treatment for extensive senile gangrene of one foot, the other being unaffected. The great toe of the sound foot was blistered while undergoing a body treatment at 300° F., and gangrene became established in the blistered area in about a week; this experience led me to adopt the practice of never treating the feet of a patient exhibiting gangrenous tendencies at a temperature exceeding 200° F.

I have seen patients with such tendencies in whom sensibility was so obtunded that they would blister with-

out having experienced the warning of discomfort at all hence it is very necessary to handle these cases with the utmost circumspection. It is, however, very desirable to induce the full physiological effect of the measure upon them, and leaving the feet outside renders it possible to apply the agent as energetically as may be desired. The other portions of the body never give trouble of this sort that cannot be overcome in some of the ways previously suggested.

Intensity and Duration of Séance.—It is believed by some operators that as long as the requisite increase in the body temperature and acceleration of the pulse-rate are secured, it does not matter, as far as the therapeutical effect is concerned, whether the patient is treated for a long period of time with a low degree of heat (250° F.) or for a short period with a high intensity (375° F.).

The writer's experience has not led him to concur in this conclusion, neither does it seem to him that the philosophy of the position is well founded. Experience shows that exposure to a low degree of heat (200° to 250° F.) requires a much longer time in which to produce the requisite modifications in the body temperature and pulse in the majority of cases, and that in some it is absolutely impossible to attain them at all with low intensities. It also shows that physical exhaustion which sometimes lasts for many hours not infrequently follows treatment so administered. Further, those who advocate this form of administration also advocate following the dry hot air application with a cold douche, which indicates that a satisfactory degree of vital stimulation does not ordinarily result from the long exposure to a low degree of heat.

On the other hand, when the treatment of high intensity is used, the requisite degree of modification in the physiological phenomena is attainable in about half

the time required by the reverse procedure, and it is almost never impossible to secure this requisite degree of modification. Instead of physical exhaustion following the treatment we nearly always observe a marked exhilaration which lasts for hours and renders the use of the cold douche entirely superfluous.

As far as actual acceleration of the bodily metabolism is concerned, and entirely aside from the patient's subjective sensations, I would say that the comparative determinations as regards the urinary constituents made by us up to the present time, indicate a constantly greater degree as resulting from the use of the higher temperature with shorter exposure.

If the increased oxidation in the tissues of the body was solely dependent upon the actual increase in its temperature *en masse* effected by the dry hot air application, then of course the long exposure and low intensity of heat would produce the same acceleration of metabolism as the short exposure and high intensity, provided that the exposure to the low degree of heat was continued long enough to increase the body temperature to the same extent; because of the greater total length of time during which *some* elevation of the body temperature would necessarily be sustained under the latter method, it might be even greater.

But it must be borne in mind that this is only one element in the equation, and that probably by far the greater portion of the increase in oxidation (metabolism) is due to reflex stimulation of the spinal nerve centers through thermic irritation of the nerve-endings in the skin. Through this stimulation is secured an augmented functionation of the organs and tissues in which the spinal distributions ramify, hence that form of treatment which effects the greater stimulation ought to produce the greater degree of metabolic acceleration;

the observations of the writer would indicate that the application of short duration and high intensity does both.

The difference in the effects of these two methods of application can scarcely fail to make itself evident as a difference in the influence secured upon the trophic and glandular functions and the physiological resistance of the patient, and this variation would be important in proportion as the necessity for sharply defined influence was urgent. In pneumonia, profound septic infection, Bright's disease, etc., the question would assume an aspect of prominence; it has therefore been considered of sufficient moment to justify discussion at some length.

After-Care.—The management of a patient who has sustained a vigorous body dry hot air treatment is somewhat important. Our custom is to leave him in the closed apparatus for ten minutes after stopping the heat, then open up the apparatus and allow him to cool, exposed to the air of the room, for twenty minutes. Usually by this time the body temperature and pulse will have returned to the normal. The pulse usually subsides more slowly than the temperature, but the patient should not be allowed to rise until it has nearly or quite reached the rate which obtained before treatment, or syncope is liable to result. One of my early patients frightened me sorely before I had learned this point, by falling in a heap on the floor, unconscious and cyanosed, on her way from the apparatus to the bath; I had gotten her up too soon.

When the pulse has subsided the patient may rise to the sitting posture and see if the exertion causes nausea, faintness, or giddiness; if it does he should lie down again for ten minutes more. If not, he may slowly and deliberately leave the apparatus and sit in a chair, preferably one which can be instantly adjusted to the

reclining position if any giddiness or nausea is provoked. If no untoward symptoms appear within three or four minutes he is ready to be taken to the tepid bath, well soaped, rinsed and put to bed. He should then have a thorough rubbing with alcohol and be left to sleep or rest for an hour, after which he may dress.

With patients who are unable to get up and about, the bath will, of course, have to take the form of a "sponge" and may be given either upon the couch of the apparatus or after the patient has been removed to his bed. The sole object of the soap and water bath is removal of the perspiratory accumulations; the alcohol rub which follows is locally stimulant and general comforting.

In some diseases characterized by a marked element of nervous debility, as arthritis deformans and various neurasthenic conditions, it is well to prolong the period of rest following the alcohol rub to three or four hours.

THE DRY HOT AIR DOUCHE.

The technique involved in this application is very simple. The nozzle of the apparatus should be located as near the skin as the patient's tolerance of the heat will permit, and the stream of air moved slowly about over the part under treatment. The nozzle should be at such distance from the skin as will permit of its being held steadily and not moved away frequently. A little care will enable one to find a distance at which the nozzle can be located without exceeding the patient's tolerance, and a steady stream of heated air at such a distance is preferable to the intermittent increases and decreases in treatment intensity which will obtain when the nozzle is held too close to the skin for a short time and then moved away to allow the protesting part to cool. The hot air douche should usually last twenty minutes and no after treatment is necessary. It may

be repeated as often as desired without harming the patient.

THE HOPKINS HEATER.

The writer has had no personal experience with this apparatus and the following description of the technique pertaining to its use in the external auditory canal is taken verbatim from one of the inventor's articles upon the subject.

Management of the Apparatus:—"(1) When the appliance becomes hot and exit is through a small opening, as in an ear-tip, the temperature of the air is proportional to the rate of flow, or degree of air pressure. Strange as it may seem, the air temperature may be increased one hundred degrees by increasing the pressure five pounds, or conversely, the temperature may be decreased by lowering the pressure. This fact enables us to regulate the temperature at will by merely increasing or decreasing the volume of air entering the cylinder.

"(2) The air temperature drops very rapidly after the air leaves the exit nozzle, and in order to secure the maximum heat the part under treatment must be as near the nozzle as possible and still allow room for escape of the used air, if a cavity like the ear is under treatment.

Preparation of the Patient.—"The ear selected for treatment is carefully examined and found to be perfectly clean and dry. A light pad of gauze (two thicknesses) is placed over the ear and with an ear speculum the gauze is pressed deeply into the canal, leaving only room enough between the tip and the tympanum for the escape of the used air.

Administration.—"The electricity is then turned on, or the gas ignited (as the case may be) and the compressed air is admitted to the cylinder under about five

pounds' pressure. It is well to give a ten or fifteen minutes' séance, increasing the temperature gradually until the limit of toleration is reached. The temperature steadily increases until the heater reaches its generating limit at that air pressure, and if the patient tolerates the temperature well it may be further increased by raising the air pressure to seven, eight, or even ten pounds, in most cases. One cannot be guided by thermometers in giving these treatments, and hence they are not employed on the new heater described. The only guide which can safely be followed is the individual toleration of the patient. But it is well to remember that the more slowly the temperature is raised the higher temperature the patient can endure without discomfort.

"Treatments are best given three times a week for from three to twelve months."

IN GENERAL.

Frequency of Administration.—This factor varies with different diseases and conditions and will be indicated, together with advantageous modifications of the technique, in the sections which treat of these diseases.

Intermissions in Treatment.—In chronic diseases, as arthritis deformans or chronic nephritis, it is desirable to suspend active treatment at intervals after the patient has once been gotten thoroughly under influence, and allow his natural vital powers to carry on their work of their own stimulated volition as long as recuperative ability is manifest. In the majority of disease processes a patient is able to recover his health only through the agency and by the exercise of these powers, and dry hot air applications simply augment them, thereby investing the various elements of the organism with the capacity for more vigorous functionation. After such

functional augmentation has once been induced, then, it is just as well to let matters alone until the physiological processes manifest the need of more help.

Most patients are also susceptible of being benefited by a change in their surroundings when such change does not involve disagreeable or detrimental conditions, and when one has been treated in a sanitarium for weeks or months, as many of them will have to be if they get the most out of the therapeutical régime, a subjection to different psychological influences will frequently do much to intensify and perpetuate the restorative tendencies of the actively applied remedial measures.

Burns.—A proper acquaintance with the technique and adequate attention paid to its execution, will render severe burns or other grave accidents entirely unnecessary of induction under all ordinary circumstances. Such lesions as do occur present no pathological features not present in the common blister except that they are usually considerably deeper; ordinary surgical treatment is all that it is necessary to apply for their cure.

CONTRA-INDICATIONS.

As we have seen, the influence of this agent under judicious administration consists of a pure and simple exaltation of normal physiological processes without pernicious reactive manifestations, which therefore results merely in accentuation of normal metabolism and of the inherent natural constitutional resistance against infective agencies or conditions which threaten the well-being of the organism. Theoretically, then, it would seem that it ought, upon general principles, to be useful in almost any pathological condition characterized by impairment of physiological function; practically, in our own experience, the inference has appeared to be very well justified, almost no contra-indications that would

stand the test of clinical investigation having been ascertained.

Atheroma and Irregular Pulse.—The belief entertained by many that patients with atheromatous arteries or irregular pulse should not be subjected to the body treatment, is a fallacy.

Clinical observation justifies the statement that atheromatous arteries are softened and rendered more functionable by the use of this measure, through absorption of lime salts deposited in their walls and, at least partial, regeneration of normal connective tissue elements; we have repeatedly treated individuals who have had previously one and two cerebral hemorrhages with none but beneficial results.

In treating patients exhibiting atheromatous phenomena it is well to run the heat up slowly during the first three or four séances, watching the effects carefully meanwhile and suspending further increase in treatment intensity when the heart and carotids begin to labor unduly; but we have never encountered the slightest cause for anxiety with them any more than with others when carefully handled.

Irregularity of the pulse coming on *during the treatment* should always be a signal for the exercise of watchfulness and usually for the termination of the application.

Valvular Heart Lesions.—The modifications of the circulatory phenomena attributable to the general dry hot air application are so similar to those brought about by the administration of alcohol, nitro-glycerine, sparteine, etc., that the position involving objection to its employment with patients exhibiting valvular heart lesions becomes obviously untenable; this subject may therefore be dismissed without further consideration.

Pyrexia.—A glance at the list of diseases in the treat-

ment of which this agent renders valuable service demonstrates that elevation of the body temperature interposes no valid objection to its administration.

Fever, *per se,* is merely a secondary result of a primary pathological factor; its degree is dependent upon the intensity of the causative process and the degree of reactionary susceptibility exhibited by the individual patient, hence its treatment should be that of the condition producing it.

It is believed by some to be directly dependent upon irritation of the sympathetic nerve centers by toxic bodies elaborated by the active primary pathological factors; by others as due to impairment of the heat inhibitory centers traceable to the same cause; and by still others it is somewhat indefinitely believed to constitute an expression of "Nature's effort" to rid herself of disability by accentuation of the normal metabolic (oxidative) processes, the increase in heat production being the logical physical result of accelerated chemical reactions, and energy transformation as represented by reflex functionation of nervous structures.

Whatever explanation is accepted, the palpable therapeutic indications suggested by modern conceptions of the etiology of fever, consist of measures tending, (1) to exalt the activity of those agencies of the organism whose function it is to resist infection, (2) to increase elimination of systemic toxæmia, and (3) to augment the functional power of those nerve centers, impairment of which has resulted in deficient heat elimination; and the general dry hot air application is extremely well calculated to accomplish all of these objects.

Another fact possessing some interest in this connection, is that patients exhibiting febrile movement usually express themselves as being comforted and tranquillized by a dry hot air application; they welcome instead of

resisting it, although at first thought it would be supposed that such an application would be intolerable to a patient who is already suffering from excessive elevation of body temperature.

Local Infective or Inflammatory Foci.—It is sometimes stated that dry hot air applications to localized inflammatory processes of any sort are dangerous and likely to transform the local into a general pathological condition. I have never heard a logical defense of this position, I have never heard of an authentic case wherein there was any satisfactory evidence that such a result was properly attributable to dry hot air, and in the hundreds of such treatments that I have administered myself and have had administered under my supervision to such cases, I have never, in a single instance, seen the slightest reason for believing that dry hot air was guilty or capable of precipitating such a disaster; I am therefore free to state my entire disbelief in the existence of any cause for apprehension in this respect.

We will now consider the practical application of dry hot air to those diseases in the treatment of which it has been demonstrated to be of value, and the order in which these diseases are considered will be found to coincide approximately with the degree of importance which the agent assumes in their management.

CHAPTER IV.

SPRAINS.

Modifications of Clinical Conditions Producible with Dry Hot Air.

Local Application.

First, immediate relief of pain, which relief can be rendered practically permanent by repeating the treatment as often as the pain returns.

Second, rapid removal of exudate.

Third, a rapidity of repair which exceeds that attainable with any other agent now known, and by reason of which, general systemic impairment due to pain or lack of exercise from confinement to the bed, chair, or house never supervenes.

General Application.

Hastening of the reparative process in all cases, and rapid removal of general debility in old cases.

RATIONALE OF THERMAEROTHERAPY.

Pathology and Symptomatology.—A sprain consists simply, in uncomplicated cases, of traumatic solution of the continuity of soft tissues about the affected joint, accompanied by severe pain and more or less impairment of function; a strictly local condition which is not inherently capable of precipitating secondary phenomena which threaten the integrity of the organism at large.

Therapeutic Indications.

First, to relieve the pain.

Second, to so influence the trophic functions of the affected part as to secure the quickest possible repair.

Third, to secure absorption of the exudate.

Local Application.

Theoretically the physiological influence of the local dry hot air treatment should be most exquisitely applicable here; practically, clinical experience demonstrates the validity of the deduction. As a matter of fact if a sprain is gotten under treatment by this agent within four or five hours after the injury has been sustained, the pain will be relieved within half an hour and all traces of the trouble will frequently have disappeared within forty-eight hours. If the case has been running on for two or three days, on the other hand, and exudate is present to any great extent, complete removal of disability will require from one to three weeks; the pain, however, is susceptible of the same immediate relief as in the early cases.

Although such results may appear magical at first thought, yet when the subject is considered from an analytical standpoint it is recognized that the agent produces its results in the same way as does every other successful treatment of the condition, viz., through its action upon the circulatory and trophic functions. The greater rapidity of repair obtained and the more effectual relief of pain, are due merely to the greater profundity of its physiological action, and its general influence in these directions is beautifully exemplified by its effects in this condition.

It is only necessary to compare the course of events marking recovery from a sprain under ordinary manage-

ment, which not infrequently extends over a period of six or eight weeks, with those just outlined in order that the immense advantages exhibited by dry hot air in the treatment of the condition may be appreciated.

If a sprain is complicated by bony fracture the local application will usually relieve the pain somewhat; less frequently it will not relieve it at all; and sometimes it makes it worse. If the treatment fails to produce practically complete relief of pain it is almost positive evidence that a fracture coexists.

General Application.

A sprain is usually sustained while the victim is in good health, and as the lesion manifests no inherent tendencies toward impairment of the general metabolic functions the body treatment is rarely called for in recent cases. In those of some standing, however, wherein the central nervous system is feeling the evil influence of long continued pain and loss of sleep, in patients exhibiting a low grade of vitality, or when repair has become sluggish from any cause the general application is of the greatest assistance.

ILLUSTRATIVE CASE.

Mrs. R. H., aged sixty-three years. Patient had slipped on a curbstone during the afternoon of May 26, 1900, spraining her left ankle. I was asked to see her in the evening, at which time severe throbbing pain was constantly present, a swelling about the size of a butternut was evident just below and anterior to the external malleolus, and the tissues in this region were so sensitive as to be entirely intolerant of any but the gentlest of manipulation. She was unable to put her foot to the floor because of the resultant excruciating exacerbation of the pain.

A local dry hot air treatment was administered at

450° F. for an hour, which entirely relieved the pain, and she was put to bed without any bandage or other local application to the foot.

May 27th, 11 A. M. Patient had been free from pain during the night and had slept well. The swelling had diminished a good fifty per cent., and only deep pressure upon the injured tissues elicited protest. Stepping upon the affected member caused her slight pain and holding it suspended downward provoked a dull, throbbing ache.

Another local dry hot air treatment was administered at 485° F. for an hour, an elastic bandage applied about the ankle in such a way as to give support to the lacerated structures and the patient allowed to be up and about at her pleasure.

May 27th, 10 P. M. Ankle had been entirely comfortable all day. Swelling had entirely disappeared, but some tenderness upon deep pressure was still observable immediately below and anterior to the outer malleolus.

The third and last dry hot air application was administered and directions given to apply the elastic bandage again next morning before she left her bed.

I saw her again during the morning of May 29th, or sixty hours after the first dry hot air treatment had been given, and all signs of the injury had disappeared; the elastic bandage was discarded and the incident closed.

TREATMENT.

Local Dry Hot Air Application.

A sprained joint rapidly becomes extremely sensitive to manipulation and when one comes under treatment, however early, the slightest movement will usually cause excruciating pain. The wrappings should therefore be applied with the utmost gentleness and when pressing them against parts that complain during administration this exquisite sensitiveness should be borne in mind.

The application should be continued for an hour and the degree of heat employed should not be less than 350° F.; in some cases it will need to be pushed to 450°

F. If the joint is superficial, the patient not obese, and little œdema present 350° F. will usually be sufficient; if the impaired structures are covered by large muscles or a thick layer of adipose or œdematous tissue, on the other hand, from 400° to 450° F. will be required.

After the séance, if the patient desires to move about the joint should be enwrapped by an elastic stockinet bandage, so applied as to support the ligaments tension upon which causes pain. When sitting or lying down no bandage is necessary but the joint should be kept elevated; observance of this latter point will frequently prevent the pain from becoming troublesome after the first treatment.

In old cases relief of pain is just as prompt but repair is slower in proportion as exudation and secondary changes in the tissues are extensive.

The local application should be made twice daily anyway and oftener if return of pain demands it.

General Dry Hot Air Application.

The technique is that usual to this procedure. It may be applied every other day until three applications have been given and every third day thereafter if its continued use should be necessary.

Additional Remedial Measures.

When dry hot air is applied early any other measure will very rarely indeed require consideration at all, but in older cases other agents are useful in combination with it.

Mechanical vibratory stimulation, the electrical currents, massage, and alternating hot and cold douche, applied daily in alternation with the thermal agent, one in the morning, another at noon and another at night,

are efficient in the order in which they are named; the two first mentioned when used alone sometimes will produce results that rival those obtainable with dry hot air.

Liniments are uncalled for, and useless except as lubricants, when dry hot air is available.

CHAPTER V.

RHEUMATISM.

Modifications of Clinical Conditions Producible with Dry Hot Air.

Local Application.

First, immediate relief of the pain however severe, which relief may be rendered practically continuous by repeating the treatments as often as the pain becomes troublesome, every four hours if necessary.

Second, shortening of the duration of the disease, the same usually lasting only from five to ten days when dry hot air is thoroughly administered in combination with well chosen drugs.

Third, lessening of the likelihood of cardiac involvement because the rapid control obtained over the condition diminishes the time period during which the infection threatens structures other than those originally involved.

Fourth, lessening of the number and quantity of medicines which it is necessary for the patient to ingest, because of the increase produced in the intensity and efficiency of their action at the seat of infection.

General Application.

Lessening of general systemic toxæmia and intensification of the physiological resistance of the organism as a whole.

RATIONALE OF THERMAEROTHERAPY.

Etiology, Pathology, and Symptomatology.—In the early seventies of the century just closed McLagon of London, England, published his belief that rheumatism

was a disease caused by a specific "Materies morbi" circulating in the blood, and that salicylic acid as a specific curative agent sustained much the same relation to it that quinine was believed to sustain to malaria; that as a disease it was in many ways and to a considerable degree analogous to malaria. Although the announcement was met by the same overwhelming skepticism and derision that has so strangely been heaped upon nearly every great discovery in the medical world since the dawn of history, yet the conviction of its truth, at least as far as the etiological element is concerned, has steadily gained ground until the profession to-day is almost ready to look upon the infectious origin of the ailment as an established fact.

Discussion of the etiological ramifications *per se* does not come within the scope of this work, and those who desire to pursue the matter further will find a masterly and convincing exposition of this view of the subject in the second volume of the "Twentieth Century Practice of Medicine," in the section devoted to this somewhat remarkable and most interesting disease. We are somewhat concerned, however, as will be seen later, with the latter part of the McLagon contention, viz.: that salicylic acid is as much of a "specific" in the treatment of rheumatism as is quinine in that of malaria.

The pathology present consists of fluid effusion into the subcutaneous tissues overlying the affected joint, the soft tissues immediately about the joint, and to a limited extent into the joint cavity; and an inflammatory process involving these structures which is intense in its nature and exhibits the well known characteristic that, no matter what the degree of severity, it never eventuates in suppuration. After an attack of true, uncomplicated rheumatism has subsided the affected joint structures spontaneously and completely resume their normal condition.

Fibrous adhesions have commonly been looked upon as forming a prominent element in the pathology of "chronic" rheumatism, but modern clinical observation and knowledge indicate that this condition is rarely, if ever, met with as a post-rheumatic lesion and that when it is so alleged the diagnosis of the original trouble should be subjected to close scrutiny.

The joint pathology is accompanied by excruciating pain in the affected part, which is increased by motion and manipulation and probably due to pressure upon the nervous structures, the presence of which, in turn, could easily be traceable to circulatory stasis in the part; and a condition of general systemic toxæmia evidenced by a moderate degree of febrile movement which is entirely irregular in its course, general malaise, and a profuse sour perspiration.

An undetermined etiology and a pathology so lacking in significant features, as far as indicating what direction treatment should assume is concerned, furnish us very unsatisfactory grounds upon which to build a rational therapy; we have therefore to depend principally upon the symptomatology and empirical knowledge for the evolution of a plan of management, and a study of the symptomatology would suggest directing our efforts toward the attainment of the following objects.

Therapeutic Indications.

First, relief of the pain, which symptom is probably due to circulatory stasis and local toxæmia.

Second, extinction of the local inflammatory conditions and restoration of joint function.

Third, reduction of the general systemic toxæmia.

Local Application.

The palliative influence of hot applications upon the pain of rheumatic inflammation has long been a matter of common knowledge and it was this fact that first led me to employ dry hot air in treating this affection; if mild degrees of heat would give some relief greater intensities might be productive of much benefit. The results which followed its use so far exceeded my expectations as to border upon the marvelous. Patients who were suffering indescribable torment were transported to a condition of ease and comfort in half an hour and would sometimes have recovered entirely in a few days; mechanics who had been unable to work for months and in whom the general condition had been much impaired by the disease were restored to health and enabled to resume their occupations in two weeks.

At the time of my original observations along this line I had not expended much thought upon the physiological action of the agent, but when we study this in connection with the causation of rheumatic pain we are no longer surprised at its efficiency in relieving the same; it is simply a manifestation of the powerful influence of the local dry hot air application in overcoming local toxæmia and circulatory stasis whereby irritation of and pressure upon nervous structures is relieved.

That the direct or indirect influence upon the local conditions other than stasis is, however, profound is evidenced by the facts that great immediate improvement in the general condition, which goes on to rapid recovery, usually follows the administration of local dry hot air applications *if an appropriate salicyl compound is given in efficient dosage along with the thermal agent;* that such improvement is much greater and recovery much quicker than when the salicyl is administered without the

dry hot air; and that a convalescence that is dragging along unsatisfactorily under salicyl treatment alone will be accelerated and rapidly eventuate in full recovery when the thermal element is added to the therapeutical regimen. The relief of local stasis and pain is not sufficient to account for these phenomena; they are explicable only upon the assumption that influence has been exerted, either directly or indirectly, upon one or more of the primary causative factors. What these factors are or in what way they respond to this influence cannot be stated until the etiology of the disease has been conclusively ascertained, but it is highly probable that auto-inoculation with specific vaccines, produced by activation of a local circulatory stasis, is largely concerned.

Conversely to the foregoing is may be as well to state here as elsewhere, that dry hot air applications *without* salicylic acid do not constitute a satisfactory management for rheumatism in any large number of consecutive cases. It will almost always relieve the pain temporarily, but it cannot be depended upon to cure the disease.

The preceding paragraph would suggest the query "Why will not dry hot air alone cure rheumatism? If, as is all but proven, this ailment is of microbic etiology it resembles, to some extent, local septic infection, and it would naturally be expected that the agent ought to exercise much the same power over rheumatism that it does (as we shall see in the following chapter) over septic infection."

We can only answer that the infective agent of rheumatism differs from other pathogenic germs. We have already noted one great and important peculiarity, viz.: that the inflammatory process of which it is provocative never eventuates in suppuration; if it differs in one particular it may safely be assumed to be capable of differing in others, and the extent and number of its

variations cannot be estimated until it has been isolated and studied.

Whatever the future may divulge as to these points the fact which concerns us in this connection remains, viz., that the simultaneous administration of salicyl compounds is necessary today, in order that dry hot air may produce its most effective influence upon true rheumatic inflammation, and it will be helpful to consider briefly at this point the relation sustained by this drug to the problem under discussion.

Is Salicylic Acid a "Specific" for Rheumatism?—The claim that this substance is as much of a specific in the treatment of rheumatism as is quinine in that of malaria, is as bitterly opposed today by many as was the claim for an infectious causation of the former disease forty years ago. In order to decide this point definitely it would first be necessary to understand the *modus operandi* by which the well known influences of quinine upon malaria and of salicylic acid upon rheumatism are brought about.

It was formerly supposed that the curative effect of quinine upon malaria was due to a toxic influence exerted by this substance upon the plasmodium, either directly or by modification of its pabulum; the advocates of the McLagon contention considered it probable that salicylic acid acted in an analogous manner upon the specific *materies morbi* of rheumatism. Recent radiological studies by King, Busc, Halberstaedter, Dreyer, and others, have, however, given rise to the conception that the curative power of quinine may be due to its property of modifying the fluorescence of the blood rather than to direct toxic action exerted upon the specific infective agent; salicylic acid is also a fluorescible substance, and the McLagon chain of analogy between malaria and rheumatism which first led its author to administer

saliçin for the cure of the last mentioned disease may thus, perhaps, be ultimately furnished with another link.

As far as the present discussion is concerned, however, the most important fact upon which the claim for specificness of the salicyl compounds has been assailed is, that they fail to cure in many cases, and some significant information bearing upon this point may be gathered by noting some of the clinical aspects of these diseases as regards response to their alleged specific remedies.

The belief that quinine bears such a relation to malaria was engendered by the repeated observations of a large number of physicians, which demonstrated that the disease almost invariably responded happily to administration of the drug in adequate dosage; many clinicians indeed hold that if a given case does not so respond the diagnosis of malaria must be changed, however well justified in the first place.

Now although this belief is so thoroughly established in the medical mind to-day, and it has stood the test of practical experience for many years, yet occasionally a victim of malaria is encountered who is taking quinine to the point of intoxication and shaking at each regular interval in spite of it. This does not invalidate the claims of the drug to specificness in our minds, however, because we know that the cause of its failure is inefficiency of assimilation or metabolism somewhere in the economy, and that when this has been corrected the drug will manifest its customary influence; the difficulty is not that the remedy has proven itself inherently incapable, but that it has been called upon to exhibit its powers under overwhelmingly inhibitive conditions. If the interfering factor is the liver, a chologogue is administered; if general debility, strychnia and iron, or arsenic; *then* quinine, and the malaria disappears.

Another prominent factor tending toward maintenance

of the reputation of quinine as a specific for malaria is the fact that remedies which have long been known and commonly used as tonics constitute efficient auxiliary agents for the removal of conditions which interfere with the exercise of its characteristic influence. Still another fact that has been favorable to quinine in this connection is that many trivial conditions which would respond to mild tonic and chologogue remedies have in the past been erroneously diagnosticated as "Malaria," hence the drug has absorbed considerably more credit than rightfully belonged to it.

As regards salicylic acid, the conditions have been very different. In the first place comparatively few practitioners have given the drug in sufficiently large quantities; one or two grams of sodium salicylate per day having been called upon to cure when two or three times that quantity should have been given, and inefficiency has, of course, resulted.

Second, many stomachs, hearts, and kidneys cannot tolerate sodium salicylate in sufficient dosage to effect the desired result, and although the substitution of salicin will usually overcome this difficulty, it requires to be given in twice as large a quantity (4 to 8 grams per day) as sodium salicylate in order that the same degree of salicyl influence may be secured, and the disadvantage contingent upon this greater bulk has generally resulted in the more irritant substance being employed.

Third, although the undeniable inefficiency of salicylic acid in some of those cases wherein adequate dosage was practicable and *practiced* would naturally first suggest, to follow out the malarial analogy, that impairment of assimilation and metabolism, local or general, was the element of interference; yet the drugs ordinarily used to remove such impairment have not proven nearly as uni-

formly successful as auxiliaries to the salicyl compounds in the attack upon rheumatism, as to quinine in that upon malaria; the logical inference being that the incapacity of salicylic acid so manifested was inherent in itself.

Fourth, many conditions exhibiting painful joints, nerves, or muscles as symptomatic phenomena, have in the past been diagnosticated as rheumatism which were not rheumatism at all, and no matter how specific the drug might be against rheumatism it would not, of course, be expected to acquire any lasting laurels under such circumstances.

Lastly, there are very few other painful conditions that would be likely to be confounded with rheumatism and which would respond happily to anti-rheumatic treatment, hence the drug would not be accredited with curative results for which it was not responsible.

It becomes apparent at once then that the opponents of the McLagon contention as to the specificness of salicylic acid in rheumatism have had good evidence upon which to base their position, and as much of this evidence is the result of practical experience it is the most difficult sort to disprove. The evolution of salicyl compounds which are not intolerable to the stomach, heart, and kidneys, whereby adequate dosage has been rendered possible, is doing away with much of it; increase in diagnostic knowledge and ability is doing away with much more; and it would seem probable that the advent of dry hot air as an efficient auxiliary measure for the improvement of local circulatory and metabolic functions might remove the rest.

Be that as it may, the fact is readily demonstrable today that the extinction of almost any attack of true rheumatism, however severe, can be as satisfactorily and positively accomplished by the proper administration of salicylic acid supported by dry hot air treatments as

can an attack of any other disease by its appropriate specific drug management, not excepting malaria. That the thermal agent is only entitled to credit as an *auxiliary measure* through which to remove conditions that interfere with the exercise of the characteristic salicyl influence, is proven by the fact that few cases respond satisfactorily to dry hot air when this agent is used alone.

The results of the employment of dry hot air in the management of rheumatism, then, may possibly forge another link for McLagon's chain of analogy and constitute another bit of confirmatory evidence as regards his contention that salicylic acid is a specific remedy in the treatment of this disease.

General Application.

The physiological action of this measure at once suggests its employment with patients who have become debilitated by a protracted attack of the disease, or when systemic toxæmia is pronounced. The validity of the inference is confirmable by practical experience.

DIAGNOSIS.

The correct diagnosis of a condition presenting clinical phenomena of an apparently rheumatic nature is a matter of the first importance, and as anti-rheumatic treatment is not only futile but occasionally positively injurious, in some conditions closely resembling this disease, the diagnosis should be made before treatment is instituted. The amount of undeserved opprobrium that rheumatism has been made to bear may be inferred from the fact that three-fourths of the cases that are referred to me with a diagnosis of "Rheumatism" *are not rheumatism at all,* and further, involve the practical point of

being disease processes that would not respond happily to anti-rheumatic therapeusis.

The more important conditions from which it is to be differentiated are as follow: arthritis deformans; neuritis; secondary neuralgias; myalgias; osteomyelitis; tubercular, syphilitic, gonorrheal, and traumatic osteitis and periosteitis; and non-rheumatic synovitis and myositis. Pressure from tumors, especially those occurring in the retroperitoneal lymphatics and which involve the nerve trunks and plexuses in these vicinities, orthopedic deformities—especially flat foot—the occupation neuroses in their earlier stages and toxæmic arthralgias deserve a much greater amount of consideration in this connection than is generally accorded them.

The diagnosis of true inflammatory rheumatism is so well set forth in the ordinary text-books that further consideration in this volume is uncalled for.

ILLUSTRATIVE CASES.

Acute Rheumatism.—I was consulted by Mr. G. L. M., forty-five years old, February 28, 1899. He had had inflammatory rheumatism two or three times before, the last attack preceding this one having occurred in 1891, at which time he was ill for three months, both ankles and the right great toe joint being involved. His father had suffered frequently and severely with inflammatory rheumatism (?) and his mother had been gouty (?). When I was called he had been suffering for two weeks, the left hip being the part involved, and during this time he informed me that he had been taking salophen and alkalithia constantly, with no result. The symptoms had increased rapidly in intensity during the preceding two days, and he had had no sleep for twenty-four hours and very little for forty-eight hours. Joint was extremely sensitive to manipulation and pressure. Dry hot air was applied locally and the pain was entirely gone in twenty minutes. At the conclusion of the treat-

ment the joint could be manipulated within certain limits without any pain. I requested the patient to call at my office the following morning if he was able. Salophen was prescribed internally, one gram three times a day.

He appeared at the time appointed, March 1st, reporting that he had experienced no pain after the treatment of the preceding day until this morning on arising from bed, but that since then it had been slightly but constantly present. He was on his way to business and had "only dropped in to let me know that he was all right." I persuaded him to allow me to treat him again, but he would not relinquish his intention of attending to his business. I treated him for an hour, with entire relief of pain as before, and he promised to report the next day.

March 2d. Patient called this morning, informing me that half an hour after leaving my office yesterday he had suffered from an acute attack of pain, lasting about ten minutes, which had then subsided, and he had felt it no more until this morning, when, for half an hour, it was quite severe. Another remonstrance as to his continuing to perform his business duties was met by the assertion that to stop at this time would entail financial loss that he was unwilling to sustain, and that as long as he continued as comfortable and as free from pain as he was then he would rather keep about his business and take a longer time for his recovery. He was treated and requested to report the next day.

March 3d. No pain since last treatment, but feels a dull soreness in parts, which is growing steadily less. Dry hot air was again administered. Patient desired to stop his salophen, but it is unnecessary to say was ordered to continue. He did not call again until March 8th, when he reported having had slight twinges of pain always in the morning on arising and occasionally during the day, but of steadily decreasing severity since the last treatment. This morning for the first time since the attack began, he had been entirely free from pain of any sort. He laughingly derided me for having desired to keep him in bed and said, as I supposed in joke, that he wasn't "going to take any more of those powders."

March 11th. Patient had continued to feel so well after

his last call that he had carried out his threat of stopping the salophen, and yesterday he began to suffer again. Resumed salophen, and toward evening grew more comfortable, but this morning pain is again quite severe. Dry hot air gave its customary immediate relief, but patient was going out of town and could not call again for treatment until two days after.

March 13th. Reports freedom from pain all day on the 11th, but it was present considerably yesterday and this morning. Dry hot air administered with the usual happy result.

March 14th. Slipped on a curbstone while running to catch a car yesterday, wrenching the affected hip badly. Suffered from excruciating pain for an hour, which then subsided, leaving intense soreness and throbbing which were present this morning. Treated with dry hot air, but pain, for the first and only time, was not entirely relieved, and the patient left my operating room with a slight limp.

March 15th. He appeared at my office at 7:30 A. M., reporting that pain returned quite severely four hours after treatment, and had stayed with him pretty sharply ever since. Insisted that he could not leave his business and remain quietly at home, and I suggested that he be treated three times that day, to which he consented. I treated him at 9 A. M., at 2 P. M. and 7 P. M., with the result that he kept about his business and had practically no pain.

March 16th. Came to my office at 9 A. M., reporting that he had had no pain until eight o'clock after rising from bed, and then only slight dull twinges. Administered dry hot air at 9 A. M., with the usual satisfactory result, and requested him to call again for treatment at two in the afternoon. He did so, informing me that he had had no pain at all since morning, and expressed himself as feeling better generally and locally than at any time since the attack began. Ordered him to come in the evening if he felt the slightest return of the pain. I did not see him again for a week.

On March 23d he came to my office early in the afternoon, supporting his right arm with his left, suffering with intense pain in his right shoulder, which he said

had commenced about 11 A. M. The slightest movement of the affected joint forced him to cry out, and when I had succeeded, with great difficulty and the utmost care and gentleness, in removing his clothing preparatory to treatment, he was shaking like a leaf. I applied dry hot air with the usual result; pain was relieved in ten minutes. At the end of the treatment he could move his arm sufficiently to get into his clothing without assistance, was perfectly free from pain, but could not raise his elbow to within more than three inches of the level of his shoulder. He had had no trouble with the hip since the last treatment, and I will say here that the recovery of this joint was complete and remained so. I directed him to call again for treatment in the evening. At that time he was suffering slightly, but was able to remove his clothing for treatment without assistance. Dry hot air was administered and directions given to call again next morning if he was in any pain at that time. I did not see him again until March 25th, when he called to tell me that he had had some slight twinges of pain during the night following the last treatment, but had remained free from it ever since. I requested him to call immediately if any more symptoms appeared, and to continue the salophen for two weeks. Five days afterward, on March 30th, he called, complaining of a dull aching in the right shoulder which I dissipated with one treatment, and that was the last of the trouble.

I quote this particular case, not because of the rapidity with which a cure was obtained, but because it is very instructive in this connection when the different phases which it exhibited are studied carefully.

First, it was treated exclusively, as far as dry hot air was concerned, with the local application.

Second, it illustrates forcibly the power of dry hot air to rapidly alleviate rheumatic pain.

Third, it exemplifies the necessity of accompanying dry hot air applications with appropriate internal medication, as shown by the severe return of symptoms in the

same old place on March 10th and 11th, after the salophen had been prematurely discontinued.

Fourth, when I state that the total length of time during which this patient was under treatment, viz., one month, is longer than that required for the recovery of any other case of rheumatism, however severe, that I have ever submitted to this management, and when we compare this period with that usually required for recovery from an ordinarily severe rheumatic attack under other methods of treatment, it exemplifies in a very gratifying manner the power of dry hot air to shorten the duration and lessen the symptomatic intensity of the disease.

Here was a severe case in active eruption in a patient exhibiting a strongly rheumatic tendency; he kept up and about his business all the time, and yet, in spite of this utter and constant disregard of one of the prime essentials to be secured in the treatment of inflamed joints, viz., rest, the attack was extinguished completely in a month. Not only this, but the patient had been kept entirely free from pain the vastly greater part of the time during that month; an achievement which could not be claimed as among the possibilities for any other treatment with which I am acquainted, however perfect might be the rest secured. When the patient can be kept at rest it has uniformly been my experience that an attack of acute rheumatism is extinguished in from five to ten days, whatever the degree of severity exhibited when it comes under treatment, and I have had cases of moderate severity recover with but three applications.

Chronic Rheumatism.—Mr. J. D., brass worker, 33 years old, was referred to us for treatment by Dr. James Stretch, of Stafford Springs, Conn., and was admitted to the sanitarium November 11, 1903. He had been ill with rheumatism for the preceding ten months, which

had involved nearly all of the large joints in his body at different times. When he was admitted the disease was manifesting itself by pain and soreness upon movement in both shoulders, the left being the worse, the right knee and the left ankle, the knee and ankle being some swollen. He was much debilitated.

He was put upon aspirin, one gram four times daily, and during the next nine days was given five body dry hot air treatments, four applications of the mechanical vibrator to his posterior spinal nerve roots, five general tonic applications of static electricity, one spinal galvanization, and two applications of the negative pole of the galvanic current slowly interrupted, to his left shoulder.

During the last three of these nine days he had been entirely free from pain and joint disability and felt so much better generally that he decided to return to work, against my advice it is unnecessary to state. Four days after his return to work he sustained a sharp return of the trouble in both shoulders. This yielded to aspirin completely in two days, however, and he heard no more of it.

This case is particularly instructive because the patient came under our care directly from a large public hospital where he had had several weeks of the best ordinary anti-rheumatic management without positive result. The addition of dry hot air and the other physical measures to the therapeutical regimen, however, produced the above marked and very satisfactory result in nine days.

TREATMENT.

Fourteen years ago in an article concerning dry hot air, the writer expressed the opinion that a "new leaf" was about to be turned in the history of the clinical results of rheumatic therapeusis, and subsequent experience has justified the inference then noted. It is in this disease that the agent has won some of its most enduring

laurels. Its mode of application and the results derivable therefrom are now well defined, and the treatment of the disorder has reached a point where it can no longer be regarded as a "Reproach to the profession."

Clinical Forms of Rheumatism.—It is necessary to divide rheumatic cases into but two classes for therapeutic purposes, acute and chronic.

It is not practicable to drop the term "chronic" rheumatism entirely at present because inefficient medication or conditions of general debility present when the infection was contracted, or which supervene because of a protracted attack will combine to cause chronicity; as previously suggested, however, great care should be exercised in making a diagnosis of chronic rheumatism.

Local Dry Hot Air Application.

The local treatment is usually the only thermaerotherapeutical modality which it is necessary to employ in the treatment of true rheumatism. If more than one joint are affected as many as possible of them should be treated at once with as many separate apparatuses. It should be applied at least twice a day at a temperature of from 350° to 400° F. for an hour until the soreness and pain in the parts have entirely disappeared. When the pain returns after the treatment the same may be applied again immediately. Usually fifteen or twenty minutes will entirely remove the pain from the most violent cases, and it remains quiescent for a variable period, ordinarily from four to six hours. By repeating the application whenever the pain returns the patient can be kept practically free from marked discomfort during the whole of his convalescence, the inauguration of which usually coincides with his first dry hot air treatment.

After-Care.—Suppression of the functions of affected

joints after the thermal application is always helpful, but not always absolutely necessary. Massage and passive movement are always unnecessary and sometimes interfere markedly with the patient's comfort, either immediately or shortly afterwards. The limb may be done up in absorbent cotton or flannel, but liniments or other external applications are usually uncalled for and useless.

General Dry Hot Air Application.

The body dry hot air treatment is always useful and occasionally necessary for removing metabolic impairment from systemic toxæmia and debility, but for the routine treatment of the disease it is not essential.

An important advantage contingent upon the employment of dry hot air applications in rheumatism is that as local metabolism is thereby kept at its point of greatest activity, assimilation of medicines by the tissues of the infected regions is rapid and complete; *less* of the drug is therefore required to be introduced into the general circulation and less systemic disturbance ensues therefrom. As a matter of fact, when dry hot air is administered in conjunction with the proper salicyl compound systemic disturbance of any sort or degree is of extremely rare occurrence.

Additional Remedial Measures.

Bier's Hyperæmia.—When dry hot air is not obtainable, artificial hyperæmia by the constriction or cupping methods is very useful. It is distinctly inferior, however, to circulatory activation produced by dry hot air.

Diet.—Rigid restriction of the diet within narrow limits in this disease is not of nearly as much importance as is ordinarily supposed. Its regulation should be governed by the manifest needs of the patient's economy and the effects of the unaccustomed conditions surrounding him

as regards lack of exercise, etc., rather than by the mere fact that he has *rheumatism.* The disease has in the past been so inextricably entangled with lithæmic and gouty conditions that the diet has been made to assume an unduly specific character. The patient should be fed as would a person sick with any other disease which had impaired his power of digestion and assimilation, and whose muscular and nervous systems were weakened by toxæmia and sluggish from lack of exercise. If his digestive powers are equal to beefsteak it may be given him without fear, as far as his *rheumatism* is concerned.

Plenty of liquid—in the form of milk (one quart per day) or water (carbonated, plain, or in lemonade) is essential for the patient's best good.

Drugs.

From what has been said in previous sections it will be seen that salicylic acid in some form should always constitute one of the principal elements of anti-rheumatic therapy. Because of its irritative tendencies toward the stomach and kidneys and its depressing influence upon the heart, however, it sometimes so impairs digestion, assimilation, and metabolism either general or local, or both, that it destroys its own effectiveness by rendering impossible its ingestion in sufficient quantity; hence the selection of the particular form in which it is to be administered is important. Those most worthy of consideration are aspirin, salicin, sodium salicylate, salophen, and methyl salicylate, and their desirability according to our experience is in the order in which they are named.

Aspirin.—This drug in doses of 3 to 4 grams per day is usually a perfectly effective anti-rheumatic and very rarely indeed produces any irritation of the stomach or kidneys or depression of the heart. Occasionally slight

tinnitus or heart-burn follows its use, and rarely a patient is encountered who cannot take it at all.

Salicin.—The bitter principle of willow bark is nearly as effective, but must be given in much larger quantities 4 to 10 grams daily), and the bulk is objectionable. Salicin has the advantage over all the others of being an excellent stomachic, and constitutes a most useful succedaneum to sodium salicylate when the latter drug has impaired digestion; it serves admirably to remove the gastric debility as well as to keep up the salicyl saturation of the blood.

Sodium Salicylate.—The gastric and renal consequences of administering this substance in full doses need only to be mentioned in order to be appreciated, but in cases where it is tolerated no drug performs better service.

Salophen.—A very useful drug which may be safely given in gram doses three times daily and does good analgetic work for a day or two, but in order to get a marked and sustained curative action larger quantities are usually required and then the heart is apt to suffer. It is, however, extremely valuable in some cases.

Methyl Salicylate.—This preparation is sometimes given by the mouth, but our experience has been that its use should preferably be restricted to external application after dry hot air treatments with those patients who cannot take any of the others in sufficient doses *per os.* Three or four thicknesses of gauze are laid smoothly over the joint affected, 5 or 10 grams of methyl salicylate soaked into it, and gutta-percha tissue wrapped around the whole and retained in place by a roller bandage. It is said to enter the circulation by absorption through the skin.

Alkalies.—The practice of administering alkalies in this affection with or without a salicyl compound is a common one, but modern conceptions of the pathology of

the disease do not furnish a logical indication for it, and although it does no harm I have never been able to convince myself that it did any good, and have abandoned it.

It will not frequently be found necessary to go beyond aspirin. This drug is not miscible with water, but by thoroughly incorporating it with an equal quantity of powdered sugar it may be suspended in the liquid, and is best given in this manner, or in konseals.

In chronic cases, where pain is not a factor demanding immediate attention, it is well to precede the first dry hot air treatment by two or three doses of the salicyl selected. We thus secure a preparatory saturation of the patient's system and the case seems to progress more rapidly thereafter. In acute cases, however, immediate relief of the constant harassing pain is imperative and the thermal application should be employed at once.

Salines.—As in every other general infection the bowels must be kept freely open, and salines are the best agents to employ for this purpose.

Electricity.

The electrical currents usually play but a secondary part in the treatment of rheumatism when dry hot air is available. When dry hot air is not at hand, however, and sometimes in combination with dry hot air they are extremely useful and may be applied as follows:

The Static Current.—The spray over the spine for its general tonic effect, and the brush discharge for from thirty to forty minutes over the seat of the inflammatory process for sedation, relief of swelling, and improvement of metabolism. Sometimes the Morton wave current is extremely helpful in this situation.

The Magnetic-Induced Current.—The rapidly interrupted current from the long, fine wire coil passed

directly through the tissues affected, for sedation and improvement of metabolism.

The Voltaic Current.—The positive pole over the affected tissues in acute cases, current uninterrupted, will frequently give temporary relief from the pain and should be tried first, but sometimes the polarities must be reversed to obtain this result. We can tell which only by trying. Occasionally a case is encountered wherein a muscle remains sore upon movement after the attack has apparently entirely ended, and here a few applications of the negative pole of the slowly interrupted galvanic current to the complaining structure will usually dissipate the trouble. In addition to its sedative action the galvanic current exercises a curative influence upon the disease through its power of stimulating tissue metabolism and removing local circulatory stasis. Its action in this direction is probably identical with that of dry hot air, but much less powerful. When the part affected is a hand, foot, wrist, or ankle, the use of a hot-water bath electrode in which the member can be immersed is much more effective. From 5 to 15 milliamperes may be used for from ten to fifteen minutes.

As all electrical modalities activate the local blood and lymph circulations, it is probable that auto-inoculation with specific rheumatic vaccines is largely concerned in the beneficial influence which they exhibit.

CHRONIC RHEUMATISM.

Treatment.—The management differs in no essential particular from that of the acute form except that as a considerable degree of general debility is nearly always present, the body treatment assumes a position of some importance in its management. It may be administered two or three times a week.

Because of this general debility other tonic measures such as static sparks, the wave current, galvanism, mechanical vibratory stimulation, etc., are most helpful. When dry hot air is not available these agents will render good service.

The drug treatment differs in only one particular from that of the acute form, viz., the addition of general tonics to the salicyl regimen.

COMPLICATIONS.

It is hardly necessary to state that any other pathological conditions which may exist when an attack of rheumatism is sustained should receive attention. Sometimes the system is so depressed by such a complication that the rheumatism cannot be removed until such complication has been attended to. We once had a patient under treatment for rheumatic polyarthritis for three weeks and were able to secure only temporary relief. At last it was discovered that she had a tapeworm, a fact of which she had previously had no suspicion. After the removal of an eighteen-foot parasite her recovery was immediate and perfect.

Endocarditis.—This complication so modifies the thermaerotherapeutical results in rheumatism as to merit special mention.

We have said that the severest cases of rheumatism are ordinarily things of the past after from one to two weeks' treatment with dry hot air, but this is by no means true in the vast majority of cases complicated with endocarditis. When the valves of the heart constitute a site of infection we have a very different set of conditions obtaining than when a joint is involved, because it is never possible to keep the inflamed structures at rest under these circumstances. The heart must

keep on working, however badly damaged it may be, and this constant massage effect results in squeezing a certain number of the infectious micro-organisms and their toxins out into the general circulation, producing auto-inoculation.

Such auto-inoculations are, of course, absolutely uncontrollable and many of them will be precipitated while negative phases of previous inoculations are operative, hence the patient will be made worse by them. Accidents of this sort are probably (at least largely) responsible for the traditional tendency towards chronicity and intermittence of endocarditis, and dry hot air is helpless under such circumstances. The local application will exercise its customary beneficial influence upon the local lesions to which it can be applied, but if the valvular lesion is constantly furnishing fresh elements of infection, its curative influence upon the course of the attack as a whole will be *nil.* This complication may, therefore, cause a case of rheumatism to go on indefinitely in spite of a vigorous dry hot air and salicyl regimen.

This does not contra-indicate local thermaerotherapy in cases in which endocarditis coexists, however. It merely means that one must not be disappointed if the usual rapid and happy result does not follow the use of the agent in such cases. Local dry hot air treatments may be applied the same as in cases in which this complication does not exist.

It is different with the body treatment, however, because of the invigorating influence which this modality exercises upon the heart action, whereby the massage effects which result in auto-inoculation would be intensified. I question very earnestly the justifiability of continuing to apply body dry hot air treatments to a patient affected with endocarditis if, during a course of

three or four such applications, the treatments are constantly followed by a rise in temperature without very material benefit being manifest at the same time. Elimination of toxæmia would be secured, to be sure, but where is the advantage of eliminating toxæmia if the process of elimination also precipitates the formation of more toxæmia? Each case can be judged, of course, only on its own merits, but I have come to feel that if three or four body treatments do not produce marked benefit in these cases they had much better be abandoned; that they may do the patient more harm than good.

CHAPTER VI.

LOCAL SEPTIC INFECTION.

Modifications of Clinical Conditions Producible with Dry Hot Air.

Local Application.

First, rapid relief of pain if applied before suppuration has become established, and partial relief if this event has already supervened. If pus confined under tension is present the pain is sometimes increased temporarily.

Second, abrupt arrest of the tendency of the disease to progressively involve structure after structure, and sharp localization of the process and products of inflammation.

General Application.

First, a marked invigoration of the vital functions indicated by improvement in the circulatory phenomena before the patient leaves the apparatus, which is not followed by any pernicious reaction.

Second, rapid relief of the nerve centers from a large degree of toxin depression, because of the increase effected in the process of elimination.

Third, abrupt arrest of the tendency of the process to involve other structures, because of the augmented physiological resistance of the threatened tissues due to exaltation of the resistive and eliminative functions.

Fourth, avoidance of evil reaction from drug stimulation, because an amount of depression sufficient to demand the employment of such remedies does not ordinarily obtain after the administration of body treatments has commenced.

One of the most dreaded of the pathological states encountered with a moderate degree of frequency today is septic infection. In spite of the most careful observance of the elaborate aseptic and antiseptic technique which has been developed from the never-to-be-forgotten work of Sir Joseph Lister, pathogenic micro-organisms will sometimes gain a lodgment in operation wounds, bringing in their train the usual accompaniment of harassing anxiety, protracted illness, suffering, and sometimes death; cuts and crushing injuries are frequently infected at the time they are sustained, or neglected then and infected later.

Prevention is, of course, the best treatment, but in many cases prevention fails and in others it is impossible of attainment, so that some effective agent for combating established septic infection will always be in demand. Dry hot air satisfies this demand in a gratifying manner.

RATIONALE OF THERMAEROTHERAPY.

Etiology and Pathology.—In order to comprehend fully the logic of the application of the agent to this disease let us glance for a moment at the pathological conditions obtaining and which it is the aim of treatment to overcome.

The primary etiological factor consists of the lodgment in the lymph spaces of pathogenic micro-organisms. After this event has occurred, one of two things will happen.

First, what we will denominate the patient's constitutional resistive power (which is represented, largely at least, by the degree in which the blood and lymph of the circulation of the infected locality are rich in opsonins and active leucocytes) may be intense enough to enable

the invaded tissue to destroy the infective organisms, in which case nothing further will be heard from them.

Second, the patient's normal constitutional vitality may be lowered from some cause or his resisting power weakened (as by impairment of the trophic nervous control from injury or shock, for instance) in which contingency the invading organisms find a pabulum suitable for their development.

Once established they multiply with exceeding rapidity, spreading colony after colony into the numerous ramifications of the lymphatic system, exhausting the leucocytes and opsonins in the local blood and lymph circulations and mechanically impeding, sometimes completely clogging, these circulatory areas whereby the bactericidal blood from the general circulation is prevented from coming into effective destructive contact with the invading micro-organisms, until finally millions of bacteria are vomiting toxins upon the contiguous tissue cells, paralyzing their vitality and rendering larger and larger areas of tissue a favorable soil for further germ propagation. These toxins, together with the ptomaines resulting from abnormal tissue metamorphosis, are taken up by the general blood circulation and brought into contact with all the nerve centers and other tissues of the body, exercising thereupon a most viciously depressing influence, whence results the evil clinical picture so harassingly familiar to most of us as "blood poisoning."

The important points to be borne in mind in this connection are, first, that when the normal resistive powers of the organism are unimpaired it is probable that it is capable of overcoming any ordinary microbic invasion.

Second, that when infective micro-organisms have affected a lodgment in the body they are immediately attacked and destroyed by the white blood corpuscles, *provided* that there exists in the blood of the part invaded

a requisite amount of as yet unisolated chemical bodies known as opsonins. The white blood corpuscles cannot digest and destroy bacteria unless the bacteria have previously been subjected to the chemical action of the opsonins.

Third, being chemical bodies, the opsonin content of a given quantity of blood will be exhausted (neutralized?) if a requisite number of bacteria are present to be acted upon by them, and if no fresh sources of opsonin supply are accessible from which to replace such as are used up by the bacteria the white corpuscles will be powerless to influence the bacteria after such exhaustion (neutralization?) has taken place.

Fourth, that the blood of the general unimpeded circulation is rich in opsonins and active white corpuscles.

Fifth, that the effect of infectious inflammation is to clog with coagulated lymph and other inflammatory products the circulatory apparatus of the part affected, so that the blood from the general circulation no longer has free access to the site of infection.

Sixth, that the opsonins are soon exhausted and the phagocytes rendered inactive, in the blood and lymph of areas thus rendered difficult of access to the blood of the general circulation by which new supplies of opsonins are normally carried to parts from which these bodies are being drained.

Therapeutic Indications.

The objects of treatment as deduced from the above, then, would be as follows:

First, to overcome the circulatory stasis in the parts affected whereby the bactericidal blood of the general circulation will regain access to the site of infection.

Second, to increase the bactericidal properties of the blood of the general circulation.

Third, to accelerate elimination from the part affected, and, if the toxæmia is at all severe, from the organism as a whole.

Fourth, to exalt general and local metabolism so as to facilitate regeneration of such structures as have been damaged by the infection.

Fifth, to relieve pain.

The local and general application have their distinct spheres of action in this disease, and it will assist in the elucidation of the problem before us if we consider them separately, bearing in mind their physiological actions as described in Chapter II.

Local Application.

When a local dry hot air application is made to one of the extremities of the body exhibiting the evidence of septic infection, the following sequence of events is inaugurated thereby.

First, the reflex stimulation of the vasomotor tracts through thermic irritation of the nerve endings in the skin, relieves the fluid stasis in the part, thereby permitting the blood and lymph from the general circulation to "flush" the capillary areas of the affected region, and relieves the pain.

Second, such "flushing" of the capillary areas of the site of infection causes a certain number of the bacteria and their toxins to enter the general circulation, thereby effecting an auto-inoculation of the organism as a whole with the specific vaccines of the very micro-organisms which it is desired to eliminate; in other words, the vaccine formula exactly appropriate to the individual infection.

Third, the integumental emunctories are stimulated to greatly increased functionation.

Fourth, the nutrition and cell vitality of the part are

augmented by reflex stimulation of the trophic nerve supply.

As a consequence, instead of the destructive process spreading farther and farther into the sound tissues, we find that the cells at the periphery of the infection, which were just beginning to feel the debilitating influences of the approaching destruction, are regenerated and carry on their metabolic and reconstructive functions with a normal, or perhaps even an increased, degree of activity, pushing the lines of healthy tissues farther and farther into the diseased areas, until finally the pathological mass is entirely replaced by healthy tissue and the patient has recovered, frequently without even a slough.

When a collection of pus is present before treatment is begun, however, it is necessary that it be evacuated, neither dry hot air or any other measure with which I am acquainted being capable of producing absorption. When pus is so present this agent exhibits another valuable attribute, viz., the power to *localize the inflammatory process* very closely to the abscess cavity when a stroke of the knife will end the trouble at once and forever.

Influence of Local Application Upon Pain.—It has been stated that local dry hot air applications will always increase the pain attending a localized septic process if pus is present, and that it is, therefore, of value as a diagnostic test for detecting the presence of suppuration. The writer has repeatedly seen the pain attending localized pus collections markedly relieved by local dry hot air applications, and has, therefore, no hesitation in expressing his lack of confidence in this measure as a differential diagnostic test.

General Application.

When the lymphatics of the joint connecting the invaded limb with the trunk have become infected, or when

severe general toxæmia is present, the physiological effect of the local treatment will not usually be sufficient to produce a cure. Under these conditions it becomes necessary to call up all of our patient's reserve forces, to stir his vital resistance against the invading organisms to its profoundest depths, and the general application is indicated.

By it is secured a profound dilatation of the capillary circulation and activation of the blood and lymph streams, not only of the part affected, but of the whole body; a more intense auto-inoculation of the organism with specific vaccines; a vast increase in elimination because the emunctories of the skin of the whole body are involved; and a much greater augmentation of the nutritional and reparative functions of the part affected because of the greater volume of the reflex impulse induced.

The hyperleucocytosis induced by the body dry hot air treatment (see chapter on Physiological Action) also probably constitutes an important element in its beneficent influence over this disease.

ILLUSTRATIVE CASES.

With regard to their treatment by this agent, cases of septic infection may be conveniently divided into three classes, as follows:

First, those in which the infection has taken place in a limb, and has not yet invaded the lymphatics of the joint connecting the member with the trunk, and which are nearly always early cases.

Second, those in which the lymphatics of the joint connecting the infected limb with the trunk have also become involved, but where the original focus of infection or other tissues have not yet become so profoundly affected as to demand surgical removal.

Third, those in which the lymphatics of the trunk are involved and tissues or glands are so hopelessly diseased as to demand immediate operative intervention.

The following reports have been selected with a view to illustrating these types; Case I exemplifies the first class.

Case I.

The writer's first experience with dry hot air in the treatment of well marked septic infection, was on September 11, 1900. A patient was admitted to the sanitarium on that date who had developed a septic process from a cut on the little finger of her left hand two days previously. She had suffered intense pain for thirty-six hours, temperature had reached 103.5° F., pulse 112, and marked prostration was present. The hand and wrist had become involved, and red streaks followed the lymphatics up the arm nearly to the elbow. A local dry hot air treatment was administered in the hope of relieving pain, which it accomplished in forty-five minutes, and the patient slept for the first time in twenty-four hours. That evening, to my intense surprise and gratification, the patient's temperature had dropped to 99.2° F., the pulse to 60, and the pain had not returned to any great degree.

By the next morning the swelling and redness had nearly disappeared, but the temperature had risen again to 101.4° F., the pulse to 84, and the pain was considerable again. She was given a body dry hot air treatment. The pain in the affected hand and arm was relieved during this procedure, and did not return again sufficiently to demand another local treatment, and, to make a long story short, the affected members progressed to a complete and fairly steady recovery during the next four days, at which time the temperature reached the normal point and stayed there.

The next two cases were reported by me in the *Med-*

ical News, issue of July 11, 1903, and illustrate the second and third types of infection, respectively.

Case II.

Mr. G. P. H., thirty-two years old, was brought to the sanitarium March 2, 1901, by Dr. A. S. Cheney, of New Haven. Four days previously he had cut his hand with a dirty jackknife. The usual evidences of infection duly appeared, and when he entered he was in a condition of profound prostration, with a temperature of 103.4° F., respiration 28, but the pulse was only 86. Hand and arm were considerably swollen. Lymphatic glands about the elbow and in the axilla were irregularly enlarged, those in the latter situation to about the size apparently of an English walnut. He was in constant, severe pain. The presence of deeply located suppuration seemed probable, but was not positively demonstrable. He had been brought in with the intention of operating the next day. It was finally decided, however, to treat him with dry hot air first, holding operative interference in reserve.

At noon of the day following his admission he was given a body dry hot air treatment at 340° F. Perspiration was profuse, the pain was relieved entirely before the conclusion of the treatment, and he had a quiet, refreshing sleep after he had been removed to his bed. The evening temperature was 102.5° F., as against 103.4° F. on the previous day.

Next morning, at eight o'clock, his temperature was 99.9° F., pulse 84. The patient had slept several hours during the night. The pain had not returned to any great degree, and the prostration and nervous symptoms were greatly lessened. The swelling in the hand and arm were less, as was also the enlargement of the glands in the axilla. He was given another body treatment at noon at 350° F. His temperature was 101.8° F., pulse 80, as against 102.5° F. and 94 respectively the preceding evening.

Treatment was administered again late in the afternoon. Morning temperature the next day was 99° F., pulse 78. Patient had slept at intervals during the night and during the day, resting quietly. That evening his

temperature was 100.4° F., pulse 76. Pain and swelling had entirely gone out of the arm, but the axillary enlargement persisted, as did also a considerable amount of pain in this region.

The following day, March 7, his morning temperature was 99.4° F., pulse 76. In the afternoon he was given a body dry hot air treatment at 350° F., and the next day his temperature in the morning was 99° F., pulse 70. In the evening the temperature rose to 100.6° F., with the pulse averaging 88.

At this time palpation of the axillary enlargement demonstrated the presence of pus, and it was decided to open the axilla the next day, which was done, at four o'clock in the afternoon, Dr. Cheney operating. Upon incision a large quantity of fluid pus was evacuated and a pocket was discovered running up under the clavicle for a distance of about three inches, of a diameter sufficient to admit of exploration with the forefinger, *but no glands outside of it were involved in the infective process.* It will be observed that this is a very different picture from that usually encountered under these conditions, where the contents of the abscess cavity consist of pus with a plentiful admixture of cheesy detritus, which it is not at all easy to remove in a thorough manner, and where gland after gland is found to be infected, necessitating a vast amount of dissection, in order that the extirpation shall be complete.

The abscess cavity was curetted out and the subsequent progress of the case towards recovery was rapid, satisfactory, and uneventful. On March 13 the body temperature returned permanently to the normal point, and he was discharged on March 23, just three weeks after his admission, entirely recovered from an attack of septic infection which was very evidently seriously threatening his life when he entered.

This case illustrates the necessity of combining operative interference with dry hot air treatments in those cases where such structures as lymphatic glands have become diseased to such an extent that disintegration is inevitable, or when pus accumulations are present. The

immediate improvement in the patient's general condition after the first dry hot air treatment, together with the strenuous localization of the inflammatory process in the axilla, illustrate respectively the happy influence of this measure in lessening general systemic toxæmia, and in preventing the spread of the infection from structure to structure, through its power of increasing the physiological resistance of the cells composing the threatened areas.

Case III.

Mr. A. W. A., aged fifty-one years, was admitted to the New York Hospital on the morning of January 8, 1902, with a traumatic amputation of the left foot at the ankle, sustained in a railroad accident. The crushed member was attached to the leg merely by the lacerated posterior tendons, and the patient, of course, was suffering considerably from shock.

Amputation of the lower third of the leg was done by Dr. Francis Marcoe that afternoon. Septic infection, however, declared itself three days after the injury. On January 12 it was noticed that the knee was swollen; on January 15 pus began to discharge from the wound, and in spite of the utmost care the condition increased until January 23, fifteen days after the original injury. At this time the leg up to the knee, and somewhat above this point, was enormously swollen, the tissues of the stump were sloughing in places, and the patient's general condition was one of extreme prostration. In short, he presented a typical picture of the severest form of blood-poisoning, except that streptococci had not been found in his blood.

It was decided to amputate the infected member above the knee as a forlorn hope. This was done by Dr. Frank Hartley on the evening of January 23, at the middle of the thigh. Patient rallied very well from the operation, and the next morning was given a body dry hot air treatment.

During the time intervening between January 24, the day of the second operation and March 8, the day of

his discharge from the hospital, the patient received thirteen body treatments, the greater number of which, of course, were given during the two weeks immediately succeeding the amputation of the thigh. His general condition began to show slight evidences of benefit at once in the way of increased comfort, ability to sleep, and improvement in the vital signs, and he continued to gain slowly but steadily until by February 5 his improvement had become so manifest as to justify a prognosis of recovery with a moderate degree of certainty. From this date on his improvement was entirely satisfactory; today his general condition is better than it has ever been in his life before, and he weighs more without his leg than he ever did with it.

In order to indicate the gravity of the case, I will say here that it was the unanimous opinion of the physicians who saw him that neither the operation or any other ordinary therapeutical measure would save the patient's life. The fact, also, that slight evidences of tissue disintegration appeared in the wound three days after the second operation, is indicative of the fact that the operation and therapeutical measures other than dry hot air would not have sufficed to secure a successful termination.

As far as I know, this agent has never been called upon to influence a case of septic infection in which streptococci were present in the general blood circulation, or a case of puerperal sepsis, but its physiological action, and what is known already of its clinical possibilities, indicate that it would be of assistance in even these ordinarily desperate conditions.

TREATMENT.

Local Dry Hot Air Application.

With cases belonging in the first mentioned category, local treatment of the affected limb is usually sufficient

to effect a cure. The technique does not differ from that usual to the local treatment, and the temperature should be run up to 300° to 400° F., according to the tolerance of the patient.

In cases of the second and third classes, the local treatment is rarely indicated except to relieve pain or to hasten sluggish healing processes after acute conditions have subsided.

General Dry Hot Air Application.

This measure is not called for in cases of the first class, unless considerable general toxæmia is present, but in cases of the second and third classes it is the remedy *par excellence.*

The technique is that usual to this treatment, except that we cannot use the temperature of the patient as a guide to the duration and intensity of the application, because it is usually considerably elevated when the patient is placed in the apparatus. The pulse also is not entirely reliable as a guide. We have to be governed more by the degree of capillary dilatation produced and the effect upon the organism as a whole, and the instinct which is the result of experience is most valuable in this connection. In general, however, it may be said that the treatment should last not less than twenty minutes and that the temperature required will vary from 250° to 350° F. The response on the part of each individual patient at each séance will govern both intensity of the heat and duration of the application. As a rule, it will not be wise to push the pulse above 140 beats per minute, and the symptoms noted under "Technique of the Body Treatment," as indicating excessive stimulation, should be carefully avoided. Pronounced dilatation of the capillaries of the face should, however, always be induced.

Usually the first indication that the toxæmia is diminishing is a lessening of the nervous erythism, which becomes manifest immediately after, and sometimes before the conclusion of the first treatment, when the patient frequently falls into a refreshing sleep, lasting from one to several hours.

The augmented vigor of the vital functions is evidenced before the patient leaves the apparatus by the improved character of the pulse and within four or five hours by a fall in the body temperature. Within twenty-four hours usually there is manifested a marked lessening or a sharp localization of the local inflammatory phenomena.

A point deserving of consideration when treating these cases is that when a patient has been severely septic for several days, as many have been before they are given the benefit of dry hot air, his nervous system exhibits the irritability of depression to a marked degree, and he is not able to endure the body treatment for half an hour. Under these circumstances the heat should be run up quickly, for instance to 300° F.. in fifteen minutes. By this means a quick and effective stimulation may be induced before the patient's endurance is exhausted, whereas, if the temperature ran up as slowly as would ordinarily be the case, it would not be possible to secure the necessary deep reflex response without forcing the length of the treatment beyond a judicious limit.

It is not necessary to protect operation wounds during body dry hot air applications with more wrappings than the rest of the body, and the proper surgical dressings will ordinarily be sufficient. The healing of such wounds is hastened by the treatments.

Additional Remedial Measures.

Bier's Hyperæmia.—When the infective process is confined to a limb artificial hyperæmia by the con-

striction or cupping methods ranks next to dry hot air as a remedy for septic infection, and when the latter is not obtainable it is the remedy *par excellence.*

Diet.—The management of the diet does not differ in any particular from that ordinarily indicated in this condition.

Drugs.—Medicines are useful to keep the bowels open and to correct digestive derangements, magnesium sulphate for the former and digestive ferments with small doses of strychnia for the latter. It is, however, very rarely necessary to give them to relieve pain or for stimulation, after the administration of dry hot air is begun.

Operative Interference.—The aid of surgical measures should be promptly enlisted whenever glands or other structures have become diseased beyond the possibility of repair, or so that their further preservation involves serious menace to the patient, and when suppuration has become established. Dry hot air will not remove moribund tissues or pus. Its great functions in suppurative cases are to relieve pain, exalt the physiological resistance to infective agencies, lessen the systemic toxæmia, and hasten repair of damanged structures, and these it accomplishes nobly and well.

Electricity.—Electricity never enters the therapeutical problem when dry hot air is available, except to assist in healing sluggish sinuses. Here the negative pole of the galvanic battery, applied to the offending granulations through a bare metal electrode, using from three to five milliamperes of current for five or ten minutes, will sometimes give excellent results. Care should be taken not to use enough current to cauterize; the good results are effected by electrolysis, not by destruction.

CHAPTER VII.

PNEUMONIA.

Modifications of Clinical Conditions Producible with Dry Hot Air.

Local Application.

First, immediate relief of pleuritic pain lasting for from one to eight hours, which is conducive to the patient's comfort, hence conservative of his vital energy.

Second, relief of that proportion of the cough and respiratory embarrassment due to the pleurisy.

Third, a marked inhibitive influence exerted upon the growth of the pneumococcus colonies in the periphery of the area of consolidation, whereby the nerve centers are relieved from a large proportion of the toxin depression which results from their unimpeded development and a decrease of febrile movement of from half a degree to one degree Fahrenheit is usually secured within twelve hours.

Fourth, rapid absorption of the exudate to such an extent that the physical signs of consolidation entirely disappear in from one to four days after the first application, which diminishes the danger of cardiac distention and removes such symptoms as may be due to encroachment upon functionable respiratory areas.

General Application.

First, a reflex stimulation of the vital powers unparalleled in extent and profundity by that producible with any other measure, and which is evidenced by marked improvement in the circulatory function before the patient leaves the apparatus.

Second, an activation of the pulmonary blood and lymph streams to an extent which, again, is unequalled by that obtainable with any other measure now known.

Third, elimination of toxins already formed and in the blood, to an extent and with a rapidity unattainable by any other means.

Fourth, reduction of excessive body temperature amounting to from half a degree to a degree and a half Fahrenheit and marked improvement in the general symptomatic phenomena, within five hours after administration.

The writer was first led to use this agent in pneumonia by his observation of its kindly influence upon a case of peritonitis, and the first case of pneumonia so treated was reported in the *New York Medical Journal* for October 2, 1899. The agent was applied to this case more in the hope of relieving the pleuritic pain than of influencing the pneumonic process, but to the writer's surprise and gratification the general and local pneumonic symptoms were mitigated as well as the pleurisy, and in subsequent cases it has confirmed its claims to respect then put forward as a therapeutical measure with which to attack this infection. At the present time the writer believes that judiciously and thoroughly (I desire to emphasize these two adjectives) applied dry hot air treatments constitute one of the most efficient means now known for combating this disease.

RATIONALE OF THERMAEROTHERAPY.

A brief consideration of the etiology and pathology of the disease is necessary in order that the rationale of its power to produce these results may be comprehended, and the conception of the same put forward by Dr. Andrew H. Smith, of New York, N. Y., carries with it more conviction than any other of which I am cognizant. Briefly, Professor Smith's explanation is as follows:

Etiology and Pathology.—The primary etiological element consists of the development of cultures of pneumococci in the pulmonary alveoli, from which toxins are absorbed into the circulation and produce the general systemic disturbance, including "heart failure." The pabulum for the growth of the micro-organisms is constituted by the fibrinous exudate which pours into the alveoli because of the irritation of their walls by the presence of the germ colonies.

That it is not an inflammation of the lung tissue in the ordinary sense is indicated by the fact that any such inflammatory process of a sufficient intensity to produce the clinical phenomena of pneumonia would very surely be followed by irreparable destruction of large masses of pulmonary tissue, whereas, in this disease after the process has subsided, the integrity of the lung structure is usually entirely restored; and that autopsical findings demonstrate that the bronchial or nutrient circulation is very rarely involved at all, but that *when it is, gangrene of the areas strangulated is very sure to result.*

This means that reflex pneumogastric irritation and, possibly, obstruction of the pulmonary or functional circulation by the exudate, are responsible for a large part of the respiratory, and at least some of the cardiac disturbance observed in uncomplicated pneumonia.

The life of the pneumococcus in artificial cultures is from ten to twelve days, and it is one of the most sensitive of all bacteria to changes in the conditions of its pabulum as regards temperature, reaction, etc. It grows best in faintly alkaline media and a marked acidity will entirely inhibit its development, hence the fibrinous exudate in the air cells during the earlier stages of pneumonia constitutes an ideal culture medium.

During the process of hepatization pneumic acid forms, and when the saturation of the exudate reaches a suffi-

ciently high point, the further development of new colonies of germs is thereby inhibited. It is by reason of this fact and the possible formation at a certain stage of an antitoxin principle, that the termination by crisis obtains. Modifications of these conditions produce termination by lysis.

Professor Smith presented the subject in detail in an address to the New York Academy of Medicine, which was published in the *Medical News* for December 18, 1899. During the course of this address he summarizes his "views as to the sequence of events taking place in an attack of pneumonia," as follows:

"1. The occurrence of some cause of depression, either local or general, which favors the germination of pneumococci, already present in some one of the smaller tubes.

"2. The formation of a colony that spreads until it reaches the group of air vessels that are terminal to the tube in question.

"3. The setting up of an irritation in these vessels, causing a fibrinous exudation, an emigration of leucocytes, and a diapedesis of red cells from the functional capillaries.

"4. The formation of a colony of pneumococci in the medium afforded by this exudate.

"5. Arrest of the blood stream in the functional capillaries, followed by accumulation of free pneumic acid in the parenchyma of the affected area.

"6. Overflow of exudate into neighboring lobules, starting the process in them also.

"7. Arrest of germ growth by the exhaustion of the medium and the accumulation of free acid in the tissue of the lung. Up to this time there has been a constant formation and absorption of toxin.

"8. Retrogressive changes in the exudate preparatory to its removal by absorption.

"9. Probably, in this latter process, formation of an anti-toxin principle.

"10. Entire removal of the exudate, and restoration of the vesicle to its normal condition.

"11. Resumption of the functional capillary circulation."

The points to be borne in mind in considering this part of our subject, then, are as follows.

First, the diplococcus of Fränkel is an organism exquisitely sensitive to changes in the character of its pabulum, and its life period in laboratory cultures is from ten to twelve days.

Second, we have a condition here which is closely analogous to that which obtains when cultures of the organism are grown in the laboratory, the walls of the pulmonary alveoli acting as test-tubes and the exuded fibrin as culture medium, to appropriate another of Professor Smith's apt illustrations.

Third, the general systemic phenomena, including "heart failure," are due to the influence upon nerve centers, muscles, and glandular structures, of toxins emanating from the germ cultures in the alveoli and absorbed into the blood.

Fourth, the most virulent toxins are produced where the colonies are youngest, hence come from the periphery of the affected area where the cultures are thinnest and spreading into other alveoli.

Fifth, in many cases, much of the cough and a considerable proportion of the respiratory acceleration, are due to reflex irritation and pain, set up by the pleurisy which usually accompanies the trouble. A bit of clinical evidence in favor of this probability is that local dry hot air applications do not *immediately* diminish the respiratory acceleration or cough much, *unless pleurisy is present.*

Sixth, death is directly due either to paralysis of nerve centers from toxin absorption, or, possibly, paralysis of the right heart from over-distention of the ptomaine impaired viscus, precipitated by massive exudate.

Seventh, when a local dry hot air treatment is applied to the lung the areas of skin affected are those concerned in the scapular and epigastric reflexes, which derive their sympathetic innervation from the spinal sympathetic ganglia extending from the first to the seventh dorsal vertebræ.

It will be noticed that this portion of the spinal sympathetic also includes those ganglia which distribute the sympathetic innervation to the lungs. The lungs, therefore, *are in reflex physiological relation* with the areas of skin which are affected by the local dry hot air application to the lung.

Eighth, circulatory and trophic modifications which are produced in the skin by local applications, are duplicated in such other structures as sustain reflex physiological relations with the integumentary areas treated.

Therapeutic Indications.

The objects of treatment may be briefly stated as follows:

First, to secure the destruction of the colonies of pneumococci in the lung, or, failing this, as profound an inhibition of their development as possible, whereby the quantity or virulence of toxins introduced into the general circulation would be diminished.

Second, to secure absorption of the exudate as rapidly as possible.

Third, to relieve pleuritic pain when present.

Fourth, to secure as rapid and profuse an elimination of the toxins already in the body as possible.

Fifth, to increase the patient's vitality and metabolic activity, whereby his physiological resistance and recuperative capacity will be augmented.

Local Application.

When a local dry hot air treatment of an hour's duration is administered to the anterior, lateral and posterior aspects of the chest wall extending from the axilla to the last rib, there is secured a profound dilatation of the capillary circulation in the skin and an augmentation of the local metabolism. The very same functional modifications are produced in the deep, internal areas which sustain reflex physiological relations to the skin of this region, viz., the *lung structures* on the same side.

As a means of satisfying the first therapeutic indication, then, we are enabled by the local dry hot air treatment to "flush" the pulmonary capillaries (of both nutrient and functional circulations) with the active bactericidal blood of the general circulation, which will destroy those of the pneumococci with which this blood can thus be brought into contact. This means, however, *only* those micro-organisms which are situated in the outermost portions of the mass of exudate immediately contiguous to the pulmonary capillaries. It would not enable this bactericidal blood to reach those germs which were situated in the central portions of the mass proper of the exudate.

[It will be remembered that we have in pneumonia a condition closely analogous to that which obtains when cultures of the pneumococcus are grown in the laboratory, i. e., the walls of the pulmonary alveoli acting as test-tubes and the exuded fibrin as culture medium containing the pneumococci, and that the blood vessels are present *only* in the *walls* of the *alveoli.* In the ordinary

case of septic infection we have the blood vessels and lymph channels ramifying extensively all through the tissues which contain the micro-organisms, hence the vast majority of the invaders can be attacked simultaneously and directly by activation of the circulatory fluids. These peculiar mechanical conditions probably render it impossible to effect by circulatory activation the same degree of auto-inoculation intensity in pneumonia as in ordinary infections, because interposition of the walls of the pulmonary vesicles between the general blood and lymph streams and the great majority of the bacteria, reduces very greatly the freedom with which sufficient numbers of these organisms and their toxins (specific vaccines) can be washed into the systemic blood. On the other hand, the pneumococcus is one of the least resistant of all bacteria, hence the same degree of vigor in attack is not necessary in order to terminate the infection.]

The most virulent of the toxins come from the youngest, peripheral colonies which are closest to the circulatory fluids, hence we should expect that destruction or inhibition of the growth of many of these would result in a lessening of the intensity of the general symptoms, and this is exactly what happens. A drop in the body temperature, an improvement in the pulse and a considerable amelioration of the nerve center depression is ordinarily evident within twelve hours after the first application.

For disposing of the pneumococci distributed throughout the exudate, another element in the physiological influence exerted by the local dry hot air treatment comes to our assistance, viz., its power to exalt the local metabolism of the part under treatment. We have noted at the beginning of this chapter that one of the constant effects of local dry hot air applications is to produce

"rapid absorption of the exudate, to such an extent that the physical signs of consolidation *entirely disappear* in from one to four days after the first application."

This exaltation of the absorptive function of the walls of the air vesicles containing the exudate constantly melts away those portions of the mass which are in immediate contact with the vesicular walls, thereby causing the contained pneumococci to be deposited upon the walls of the air vesicles where the lymph and phagocytes from the systemic blood in the vesicle walls can come in contact with and destroy them.

It fulfills at the same time the second therapeutical indication.

A fact worth recalling in this connection is that in the vast majority of cases of pneumonia, whatever treatment is administered, *the exudate disappears by absorption and not by expectoration.* So this remarkable hastening of its disappearance under dry hot air applications is merely an intensification of a normal functional process, an *acceleration* of the *usual* course of events which the physiological action of the local dry hot air treatment would lead us to expect.

The power exhibited by local dry hot air applications to exalt normal metabolic processes may have still another bearing on this problem. In a previous paragraph we have noted that the pneumococcus is one of the most sensitive of all bacteria to changes in the conditions of its pabulum (reaction, etc.), that "during the process of hepatization pneumic acid forms, and when the saturation of the exudate reaches a sufficiently high point, the further development of new colonies of germs is thereby inhibited," and that according to Professor Smith's conception of the sequence of events which takes place in an attack of pneumonia "the accumulation of free acid" (pneumic?) "in the tissue of the lung" constitutes one

of the constant, normal, metabolic phenomena of the disease. To exalt the normal metabolic processes, then, would involve a hastening and amplifying of the "accumulation of free acid" (pneumic?) "in the tissues of the lung," and a quicker termination of the lethal tendencies of the infection, all of which is in entire accordance with the clinical findings.

Just how much credit is attributable to pneumic acid as a terminating factor in an attack of pneumonia, as compared with activation of the blood and lymph streams and auto-inoculation with specific vaccines, or whether the curative thermaerotherapeutical results involve a combination of both is, of course, an open question, but the mechanical separation obtaining between the blood current and the germs at the actual site of the infection hereinbefore set forth, would indicate that it may be considerable.

A logical deduction from the above would be that, under thermaerotherapeutical management, pneumonia would tend to terminate by *lysis* rather than by crisis; that the patient would continue to feel, though with decreasing intensity, the effects of such toxins as emanated from the still undestroyed bacteria; and that even after the exudate had disappeared to such an extent that no physical signs of its presence were detectable, the ideal character of the pabulum (exuded fibrin) and the difficulty which surrounds the bringing of the bactericidal systemic blood into contact with the pneumococcus cultures in the air vesicles, would result in the persistence and, to some extent, the continued propagation of some of the younger and more vigorous colonies, until the normal life period of the infection (from ten to twelve days) had terminated, and this, again, is exactly what happens. Such destruction or inhibition of pneumococci as results from each treatment relieves the patient in some degree

from his toxæmia, whereupon he exhibits a marked and immediate improvement, but does not recover entirely until the infection has reached the period of its normal defervescence.

Further, in this connection, it would be expected that, if the dry hot air applications were discontinued too soon, the germ colonies would again multiply so as to produce some amount of consolidation and an increase in the systemic disturbance. Bedside experience also validates this expectation.

It is significant, with reference to the foregoing, that Dr. Beverley C. Kinnear, of New York City, used heat with beneficial results in the treatment of pneumonia, in the form of hot water bags or flannels wrung out of hot water, continuously applied, previous to 1898. His paper upon this subject was published in the *Boston Medical and Surgical Journal* for December 2, 1897. He made his applications over the dorsal sympathetic ganglia, and believed the effect to be due to reflex influence exerted upon and through these structures. Baruch and Diefenbach of New York, Kellogg of Battle Creek, and others recommend wet compresses and friction to the chest. All of these measures would, of course, activate the pulmonary circulation and accelerate local metabolism.

The application of cold in the form of ice packed about the chest has also been employed with benefit in this disease and the secondary effect of this measure would also be to activate the pulmonary circulation and local metabolism. The patient's vitality, as represented by his reactive powers, constitutes a large element in securing a favorable effect from cold applications, however. When heat is employed, this factor does not enter the equation, as he has had nothing administered that demands reaction for the development of its benefits; its favorable influence is direct, inherent and immediate.

An incontrovertible elucidation of the exact manner in which these effects of hot and cold local applications in pneumonia are brought about is at present impossible, nor is it necessary for our present purposes. The vital point is that they *are* brought about, and that this is so is now attested by a large number of observers.

The pleuritis accompanying pneumonia yields completely to the local dry hot air treatment in from twelve to forty-eight hours. The profound circulatory activation produced is sufficient to account for this result.

General Application.

Occasionally a case is encountered where the patient's excretory organs are incapable of eliminating the toxins with sufficient rapidity, and a depression of nerve centers develops which threatens speedily to end the scene and the patient.

This condition may be brought about by defective renal function, a low condition of the patient's vital powers when the infection was sustained, or a particularly virulent type of infection. Whichever the cause, the local treatment is ordinarily useless, because it could not possibly influence the kidneys to any degree when applied to the lung and the small area of skin subjected to its influence does not contain enough nerve endings to make possible a reflex stimulation of the spinal centers profound enough to overcome a general debility of this character. The only resource then becomes the induction of profuse and rapid elimination from a larger area of the skin, an arousing of the kidneys and lungs to increased function, a strong stimulation of the spinal centers which are being overwhelmed, and the profoundest circulatory activation possible of attainment, and the body dry hot air treatment enters the arena. As will be

seen by referring to its physiological action, it possesses the power to accomplish all of these objects in an eminent degree.

ILLUSTRATIVE CASES.

The following instance exemplifies very well the effect of the local application upon the ordinary case of pneumonia:

Case I.

Mr. G. W. P., age thirty-four years, a clergyman by occupation. I saw the patient first on March 29th, 1900, at 9 A. M. He had been in his usual health until the preceding evening when he had begun to feel "badly all over," and had noticed a sharp pain under his left nipple. This had grown worse during the night, and towards morning he had begun to cough some, which increased the pain, as did also deep respiration. Auscultation and percussion elicited nothing abnormal. His pulse was 76 per minute, respiration 20, temperature 98.6° F. It looked like developing influenza, and the patient was sent to bed and an anodyne cough mixture prescribed.

March 29, 7 P. M. The cough had increased during the day and the pain under the nipple was now harassing in the extreme. Severe headache had developed, but there was no expectoration. Pulse was 100 per minute, respiration 48, temperature 101.6° F. Physical examination discovered a few crepitant râles and a marked pleural creak, but no dullness. I made a diagnosis of commencing pneumonia, directed that a hot water bag be applied over the site of the pleurisy, and that five grains of antikamnia be given every hour until the headache was relieved.

March 29, 11 P. M. The pain had lessened somewhat under the influence of the hot water bag and ten grains of antikamnia, and this drug was then discontinued. Slight dullness had developed over the lower lobe of the left lung. Pulse was 98, respiration 48, temperature 100.6° F.

March 30, 8 A. M. Patient had been very restless during the night, and had slept but little. Headache and pleuritic pain had increased after midnight, and were now again extremely harassing. He was expectorating a green viscid mucus, which adhered to the bottom of an inverted dish. Pulse was 100, respiration 42, temperature 100.8° F. Dullness was now marked over lower lobe of left lung.

Patient was greatly prostrated, and his pain, frequently exacerbated by coughing, was increasing his prostration, but I hesitated to give him morphine because he was of a markedly neurotic temperament, and I also feared the respiratory depression so frequently dependent upon its administration under these conditions. I decided to try baume analgesique, applied over the pleurisy with a hot water bag over it, and directed that I be notified if no amelioration occurred by 11 o'clock A. M.

I was so notified, and decided to treat the consolidated lobe with dry hot air, which was done at noon. At the end of the treatment the pleuritic pain was entirely relieved, except when coughing violently or upon forced respiration, and the pulse had dropped to 96, respiration to 28. During the morning the sputum had become blood-stained, and was now typically pneumonic.

March 30, 8 P. M. The pleuritic pain had remained in abeyance until 6 P. M., but had been very severe since. Pulse was 100, respiration 56, temperature 103° F. Dry hot air was again administered, completely relieving the pain as usual, and at the end of the treatment the pulse was 94, respiration 38. I left the patient resting quietly.

March 31, 9 A. M. He had continued to rest comfortably until 2 A. M., when the pleuritic pain had begun to return, and it was now severe again. The cough had greatly lessened and what little sputum he raised was rusty and very tenacious. Pulse was 96, respiration 32, temperature 102.2° F. The dullness over the affected lobe was markedly less, and numerous coarse râles were present. Dry hot air was administered.

March 31, 9 P. M. Patient had no pleuritic pain during the day, but at 8 P. M. it had returned nearly as severely as before. Sputum had become much lighter in color during the afternoon, and was much less tenacious. Per-

cussion betrayed only a very small area of slight dullness over the affected lobe, and the coarse râles, so plentiful in the morning, were disappearing. Pulse was 100, respiration 30, but had dropped to 28 at noon, and temperature was 102.2° F. Dry hot air was administered.

About fifteen minutes after treatment was begun the pleuritic pain disappeared, and patient remarked how good it seemed to be free from it. Shortly afterward he exclaimed, "Oh, how queer I feel!" I asked him what the matter was and he tried to, but could not answer. His eyes closed, muscles relaxed, and he appeared to have fainted. I felt the pulse; it was very soft, and the respiration, as well as the pulse, had become very slow. His lips were blue and the skin on the face ashen. I immediately removed the apparatus, threw the clothing from his body, and had the nurse fan him vigorously, while I opened a window and got a hypodermic of strychnia ready. It was not needed, however, as in a minute or two he revived, opened his eyes, and his pulse and respiration resumed their former rate and character.

By evening of the next day, April 1, the physical signs of consolidation had entirely disappeared, but râles were still present, and they persisted in some degree in this situation for about a week.

From this time until April 4 the only noteworthy event was an acute œdema of the lungs, lasting about six hours, which occurred in the morning of April 2. For thirty-six hours previously the patient had suffered from a headache which had utterly resisted the ordinary analgetics, and which had become so severe that I was obliged to resort to morphine hypodermically during the night of April 1. The œdema yielded to hypodermics of strychnia and atropin in about five hours.

Shortly after midnight of April 3 the patient became slightly delirious, and about three o'clock in the morning of April 4 pleuritic pain appeared over the lower lobe of the right lung. I saw him at 8 A. M., at which time his pulse was 104, respiration 38, temperature 102.4° F. The original focus of infection in the lower lobe of the left lung was in a satisfactory condition, but dullness had appeared over the lower lobe of the right lung. I called again at noon and found that the dullness which

was present in this situation in the morning had increased to flatness, and the sputum was bloody. The general condition was about the same as in the morning. Dry hot air was applied over the lower lobe of the right lung.

April 4, 10 P. M. Patient had passed a very comfortable afternoon. Sputum was rusty. Pulse 106, respiration 36, temperature 101.6° F. The flatness over the lower lobe of the right lung had decreased to dullness, and dry hot air was administered again in this situation. During the evening Dr. Rollin McNeil, of New Haven, saw the case with me in consultation, and did me the honor to observe its subsequent course. As the patient was excessively prostrated, I remained with him during the night.

April 5, 8 A. M. Patient had developed a severe lumbar myositis in both sides, but especially marked in the right, which had first manifested itself about 4 A. M. Spasms in the affected muscles were frequent and painful, and extreme tenderness to the touch was present. I directed that mustard pastes be applied over the affected structures.

April 5, 10 P. M. Muscular spasm and pain had been only slightly relieved by the sinapism, and the patient had suffered considerably from them during the day. The slightest movement on his part, or manipulation by anyone else, would set up the spasm. Pulse was 94, respiration 34, temperature 100.2° F., and general condition much the same as in the morning. Physical examination demonstrated that dullness was present only in spots over the lower lobe of the right lung, and that air was entering pretty freely every part of it.

Dry hot air was administered again and the cloth attachment was carried downward and backward so as to include the inflamed muscles. At the end of the treatment the patient could cough, respire deeply, and move about in the bed, and the parts could be manipulated without causing spasm or pain. The patient's continued extreme prostration decided me to remain again by his bedside during the night.

April 6, 8 A. M. Patient had passed a very comfortable night, sleeping most of the time. Had suffered slightly from muscular spasm about 2 A. M., but at this

time only very slight soreness upon manipulation was apparent, and patient could move freely without exciting any spasm or pain. Sputum had lost its rusty character and was opaque, whitish, and somewhat frothy. Pulse 92, respiration 28, temperature 99.2° F. Dullness had disappeared entirely from the lobe last affected, but some râles were still present in this and also in the lower left lobe.

From this time on the patient's recovery was steady and uneventful, except for a short, but pretty sharp, return of the myositis on April 8, which was readily controlled by dry hot air locally. The temperature returned permanently to the normal on April 22, with a pulse of 76, and respiration of 18, but it had not been higher than 99.2° F. after April 4. The extreme prostration, which had caused me so much anxiety on April 5 and 6, had disappeared rapidly after April 8, and the convalescence was entirely satisfactory in every respect.

It will be observed that in this case the administration of dry hot air produced the following results:

First, immediate relief of the pleuritic pain, which relief lasted for several hours after treatment.

Second, a decrease in the frequency of respiration, probably due to relief of the pleuritic pain, and which on the evening of March 30 amounted to twelve cycles per minute.

Third, lessening of the cough.

Fourth, a drop in the body temperature amounting to from half a degree to one degree, F. It will be observed that after the second treatment the temperature did not at any time rise above 102.2° F. until the morning of April 4, when the right lung became involved, and even then it only reached 102.4° F., an unusually low temperature for an ordinarily severe case of pneumonia.

Fifth, entire disappearance of the physical signs of consolidation within forty-eight hours after the first treatment was administered.

It also exemplifies, during the administration of the treatment on the morning of March 31, the cardiac disturbance that sometimes occurs when the lower lobe of the left lung is being treated.

Case II.

As previously stated, when profound general toxæmia is present, the general application is the measure to be employed, but that the influence of the local application upon the toxin-producing factors at the site of infection is, in rare instances, sufficient to avert a fatal termination was evidenced by a case which occurred in the practice of Dr. B. S. Lewis, of New Haven, Conn.

The patient, a woman, about fifty years of age, had been suffering from pneumonia in the lower lobe of the right lung for several days and had become comatose from toxæmia during the late afternoon of May 4, 1900.

Dr. Lewis called Dr. Rollin McNeil in consultation upon the case; they agreed that no ordinary therapeutical measure offered any hope of saving the patient's life, and invited me to administer dry hot air.

I repaired to the patient's bedside at once, in company with the gentlemen just mentioned, and administered the first treatment at 11 o'clock, P. M. At this time the patient could not be aroused, subsultus tendinum was present, her pulse was 130, weak, compressible, and thready, respiration 33, and she was evidently failing rapidly; no pleurisy was or had been present. The pulse improved before the treatment was concluded, and shortly afterward the nervous symptoms decreased, but the respiratory acceleration showed no sign of abatement for several hours, *probably because no portion of it was due to pleurisy.* When we called to treat her again the next morning she was conscious, the pulse and other symptoms had continued to improve, and she went on to convalescence and complete recovery.

Other cases in which I have relied upon the local application to overcome profound general toxæmia, however, have died and I do not now consider it justifiable to postpone the body treatment under these conditions. One of the fatal cases just referred to, occurring in the practice of Dr. Walter C. Skiff, of New Haven, Conn., was of particular interest because of the fact that the physical signs of consolidation had entirely disappeared eighteen hours after the agent was first applied, yet the patient died in a few hours just the same.

TREATMENT.

Local Dry Hot Air Application.

The local application of this agent is, in many cases, the only thermaerotherapeutical measure required in pneumonia, and the appropriate technique is as follows:

A piece of cheap Turkish toweling, four or five feet long and eighteen or twenty inches wide, is folded twice, so as to make three thicknesses, and applied closely against the skin over the affected portion of the lung. This is held in place by two or three pieces of webbing one inch in width, supplied with buckles at one end, and long enough to pass clear around the body. The patient is then brought close to the edge of the bed and supported by pillows in such a way that the apparatus can be attached directly over the area to be treated.

The heat should be run up to from 275° F. to 350° F., according to the patient's tolerance, and the duration of the treatment should be from half an hour to an hour. Victims of this disease find it extremely irksome to lie in one position with the affected lung uppermost, for an hour, but the treatment should be continued for this length of time if it can be done without provoking undue exhaustion, and judgment and experience must govern

on this point. Treatments of less than half an hour are of little, if any, use.

When treating the lower lobe of the left lung, it should be borne in mind that acute dilatation of the heart is sometimes induced and the pulse and respiration should be constantly watched. If untoward symptoms appear, the apparatus and wrappings should be immediately removed, and the patient's body exposed and fanned. Usually this will take care of the condition in a few seconds, when treatment may be resumed. If the patient does not revive at once, towels wet in cold water should be slapped over the chest and abdomen, and strychnia injected hypodermically.

After-Care.—When the treatment has been completed, the capillary area which has been subjected to its influence will be found to have become deeply injected and covered with profuse perspiration. This secretion will also usually be in evidence to some extent on other parts of the body. It may be removed with a dry towel, the area treated wrapped in one thickness of flannel, and the patient made comfortable again in bed, but poultices and pneumonia jackets are entirely uncalled for when dry hot air is obtainable.

The application should ordinarily be repeated every twelve hours for the first two days, and once daily thereafter until convalescence is established.

General Application.

The patient is prepared for treatment in the usual way and placed in the apparatus, and the heat is run up as rapidly as possible to 275° F. or 300° F. If perspiration or marked flushing of the face is not induced by this temperature, the same should be increased until it is, or until the patient's tolerance is reached. The

treatment should last from twenty minutes to three-quarters of an hour, according to the effect produced.

As the body temperature of the patient is usually already high when he enters the apparatus under these conditions, it is useless as a guide to the duration of the séance, and the pulse and general effects must be relied upon for guidance; another situation where good judgment and experience are friends in need and indeed. In a general way, however, it may be said that the pulse should not be accelerated beyond 140 beats per minute, and that when sedation of the nervous system or dilatation of the capillary circulation—as evidenced by decided flushing of the face or general perspiration—has been induced, it is time to stop. Over-stimulation means exhaustion, which should be avoided, and a patient in the throes of a severe pneumonia is especially susceptible to its induction.

The after-care does not differ from that of the body treatment in general. The beneficial influence of the treatment upon the heart and nervous system is frequently apparent while the patient is still in the apparatus, and it lasts from twelve to twenty-four hours usually. The application may be repeated when the patient begins to fail again.

Heart Failure.—This symptom is sufficiently important to merit brief special mention in this connection. It is due either to massive exudate (?) or systemic toxæmia, or a combination of both. Massive exudate will usually yield to the influence of the local treatments with sufficient readiness to save the patient, but these applications are not effective in relieving the symptom when due to systemic toxæmia. The body treatment only is efficient here, and in view of the fact that the patients almost always die under all other methods of treatment when reduced to this extremity, it is justifiable to move

them in an ambulance from their homes to a hospital if they cannot be gotten to a body apparatus in any other way. As the treatment would be applied immediately, the evil result of any ordinary exposure sustained during the journey would be remedied at once, and the patient would thereby get the benefit of almost the only therapeutical measure that offers him a reasonable hope of recovery.

Additional Remedial Measures.

The other forms of physical therapeutics never enter the problem of the treatment of this disease when dry hot air is obtainable, but medicines are important.

Drugs.—Professor A. H. Smith, cited previously, advocates the administration of drugs which are excreted largely by the lungs, and which are inherently inimical to the development of the pneumococcus. The extreme sensitiveness of this organism to conditions pervading its pabulum renders several drugs available for this purpose, among which may be mentioned creosote carbonate, the salicylates, large single doses of calomel, and quinine; under ordinary circumstances the administration of these substances is not deleterious to the patient.

The two first mentioned are Professor Smith's choice, the clinical results he reports are excellent, and the author desires hereby to add his testimony to that of other observers, as regards the favorable influence of creosote carbonate at least.

The weak point in this method of attacking the germs is that some stomachs, kidneys, and nervous systems cannot stand the drugs advocated in sufficient quantities to render possible the induction of their antiseptic influence, and that medicines excreted in this manner do not penetrate to the germ colonies deeply located in the

consolidated area. They do, however, reach the youngest of the colonies, which are spreading at the periphery of the consolidation and giving rise to the most virulent of the toxins.

The drug management of the symptomatic phenomena of the disease does not differ from that applicable under other circumstances. Strychnia, whiskey, sanguinaria or sanguinarin, small doses of tartar emetic, bryonia, phosphorus, etc., all have their places as stimulants, expectorants, etc., but when dry hot air is given they will sometimes never be indicated at all, and when they are it will be for a shorter time and in much smaller quantities than under other conditions.

When the respiratory area has been greatly encroached upon, oxygen inhalations are extremely helpful and constitute a fairly efficient nerve stimulant as well.

CHAPTER VIII.

ALBUMINURIC NEPHRITIS (BRIGHT'S DISEASE).

Modifications of Clinical Conditions Producible with Dry Hot Air.

Local Application.

This measure exercises no appreciable influence upon the essential characteristic symptomatology or pathology of the disease, and may be dismissed at once from further consideration in connection therewith.

General Application.

First, relief of the headache, nausea, respiratory and cardiac embarrassment, sometimes before the patient leaves the apparatus, and usually within twelve hours.

Second, increase of the urinary excretion and of the total urea output in cases wherein these factors are deficient, whereby the general toxæmia is lessened.

Third, diminution of the total quantity of albumin voided in the urine, at least when such quantity is large, and sometimes complete elimination of this abnormal constituent.

Fourth, diminution of the dropsy within twelve hours usually, and sometimes its entire disappearance within four or five days.

Fifth, absence of the evil after-effects of drugs which it is sometimes necessary to administer for the control of severe symptoms, because such symptoms are effectually removed by dry hot air, which produces no vicious reaction when judiciously and properly administered.

Sixth, restoration to perfct health of some of the victims of this disease, and to apparent health and unimpaired usefulness of a large number.

RATIONALE OF THERMAEROTHERAPY.

Etiology.—Unfortunately, a positive knowledge of the primary etiological factors of this disease is not available at the present time, but the general symptomatology and local tissue alterations are such as to point with a strong degree of probability to the presence in the blood of some toxic bodies irritant to the renal structures during excretion, and which are developed by reason of some disorder of the functions concerned in digestion, assimilation, or oxidation. If this proves to be true, the disease will ultimately have to be transferred from the category of the renal to that of the constitutional disorders; a general systemic toxæmia or impairment of general metabolism, of which the changes in the kidneys are but secondary local manifestations.

The manner in which the disease responds to dry hot air applications strengthens this conception of its causation, as does also the fact that the only therapeusis that has ever been of value in the condition is that which has had elimination of some sort, or increase of oxidation in the body, as its object. The clinical aspects of the disease are also strongly indicative of systemic toxæmia of some sort.

Speculations as to the primary etiology of the disease are at present fruitless, however, and fortunately positive knowledge upon this point is not necessary, so far as the use of dry hot air in its treatment is concerned. We can derive an ample number of rational indications for its employment from the well known clinical phenomena.

Symptomatology and Pathology.—Let us consider briefly some of the most prominent and constant of these

clinical manifestations, and see if it is possible to deduce anything as to the causative factors, which will constitute a logical basis upon which to construct a rational therapy.

First, there is frequently present dyspnœa of variable degree which is sometimes due to interference with the respiratory movements through fluid accumulations in the abdominal or pleural cavities, but which also sometimes seems to be due to irritation of the nerve endings in the pulmonary mucosæ by the excretion of abnormal, irritating bodies from the blood current.

Second, dropsy, which might be due to change in the blood pressure from insufficiency of the cardiac or arterial impulses, changes in composition of the blood serum, or irritation of endothelium from toxic bodies circulating in the blood current.

Third, digestive disturbances, which could also be due to excretion by the alimentary mucosa of toxic bodies present in the general circulation.

Fourth, a variable degree of bronchitis, indicating an abnormal, irritant condition of the excretions of the pulmonary mucosæ.

Fifth, affections of the skin, explicable upon the assumption either of toxæmic trophic aberration, or the presence in the integumentary excretion of abnormal, irritant matters.

Sixth, a quickened heart action, accompanied by increased arterial tension, easily explicable upon the assumption that the blood current holds in solution some irritant body or bodies.

Seventh, headache, dizziness, insomnia, increased general nervous and muscular irritability, sometimes eventuating in the most pronounced convulsive seizures; all strikingly indicative of the presence of toxic contamination of the body fluids.

Eighth, the total urinary output in the ordinary chronic

form of the disease, is usually somewhat in excess of the normal, with lowered specific gravity, a phenomenon easily interpretable as the result of renal irritation, due to the presence in the blood of an abnormal toxic element. In the more acute seizures or exacerbations, a diminution in quantity obtains which reaches the point of complete suppression when the inflammation of the secreting structures attains a sufficient degree of intensity; and this inflammation again is undeniably dependent upon some antecedent irritation.

Ninth, the fact that albumin is usually found in the urine is explicable upon the same causative hypotheses advanced in connection with dropsy, one of which, it will be remembered, involved the presence of some irritating body in the general circulation.

Tenth and last, the structural changes in the kidneys of true Bright's disease are just such as we should expect to find as the direct or remote result of inflammatory action, which again presupposes the presence of the element of antecedent irritation.

A general debility of varying degree, frequently amounting to profound prostration, also usually accompanies the development of the renal symptoms.

We have, then, ten of the cardinal elements which combine to form the clinical and pathological picture of Bright's disease of the kidneys, and four of the minor symptoms, for the explanation of every individual one of which the hypothesis that an abnormal substance or substances possessing toxic and irritant properties is contaminating the general circulation would be sufficient; and I do not know of any evidence tending to show that such a product and condition do not exist in this situation, or that their existence would not be sufficient to explain all of the pathological and clinical phases of this ailment.

Nature of Specific Toxin.—The next inquiry that would naturally follow in this line of reasoning would be, "What is the nature and evolution of this abnormal toxic irritant?"

We find that the urine of Bright's disease commonly exhibits a deficiency in the quantity of urea normally present, and the first thought would be that accumulation in the blood of an intolerable amount of this product of catabolism was the offending factor. Indeed, this view of the matter was, for many years, very generally accepted, but there exists some evidence tending to show that another solution of the problem invites consideration.

First, although the urine is deficient in urea, yet that does not necessarily prove that the missing quantity has been retained in the blood, as *urea.*

Second, it has been found that urea injected into the veins of animals produces scarcely any general disturbance, *unless the kidneys have been extirpated or their blood vessels tied off.*

Third, although death always follows the extirpation of both kidneys or ligation of their blood vessels, yet this does not necessarily prove that death, under these conditions, is due to retention in the blood of urea, and further, uræmic phenomena do not by any means *always* accompany dissolution under these conditions. The element of shock, which the total destruction of an element so vital to the preservation of the organism as is the renal function, would enter into the problem with a force that cannot be estimated, and that might in itself, and exclusive of all other causes, be sufficient, in its remote reflex and indirect influences upon other functions and the general bodily metabolism, to produce death.

Fourth, cases of complete suppression of the urine for periods varying from five to twenty-five days, and exhibit-

ing no increase in uræmic signs, are not so very uncommon in medical literature. In these cases the blood is frequently loaded with urea, and increase in the uræmic symptoms could hardly fail to appear if *urea* were the active cause of them.

Fifth, although the induced perspiration of Bright's disease is said to exhibit a marked increase in its toxic properties, yet the quantity of *urea* constantly found therein bears no adequate proportion to the amount of benefit dependent upon the induction of perspiration.

Sixth, urea in excess is by no means always found in blood drawn during uræmic seizures.

Seventh, urea is a normal, therefore an unirritating excretory product of the kidneys, and no evidence is at hand to indicate that these organs would be unable adequately, and with safety to themselves, to excrete any amount of it which the bodily metabolism was capable of elaborating, or that urea, in itself, is capable of provoking inflammation in these organs, however great the quantity which they may have been called upon to dispose of; and inflammation of the renal excretory structures of some degree is an invariable concomitant of uræmic manifestations.

Eighth, if we assume that an excessive amount of urea in the blood is the essential causative element of uræmic phenomena, we must necessarily also assume that one of two antecedent conditions obtains in order to account for its presence there.

First, that the primary and initial lesion is the inflammatory process in the kidney, by reason of which the kidney is so crippled that it is unable to excrete the normal quantity, whereby the same is thrown back into the blood current; and there is no satisfactory evidence available to support this supposition.

Second, that some aberration of metabolic function

causes urea to be elaborated in such quantities that the kidney is unable to excrete it; and, as stated above, there is no conclusive evidence available to indicate that *urea* is so present, that it would be possible for the organism to elaborate urea in sufficient quantity to produce this effect, or again, that urea would be able in any possible quantity to produce the inflammatory renal pathology which is always observed in this disease.

These facts are vital, and any theory that does not satisfy their claims is not entitled to unmodified acceptance.

Therefore, it would appear that there is justification for looking for something besides urea, as the direct exciting cause of uræmic phenomena, and as inflammation of the kidney structures, which would partake of the nature of an *external* factor, can be disregarded as a primary cause, we must look for the origin at the other end of the equation, that is, *within the body.* Now, urea is a substance of a moderately high degree of oxidation, and, as the clinical phenomena of Bright's disease by no means constantly indicate that excessive oxidation is taking place, we must consider that it is among the *sub*-oxidation products or *structural antecedents of urea* that we may expect to find the characteristic toxin.

Finally, it will be instructive, in this connection, to ascertain whether or not the actions of remedial measures which have hitherto been found useful, will shed any light upon the subject.

This point may be disposed of very briefly, and as follows:

Every therapeutical measure that has attained a lasting place in the popular management of this disease has exerted its principal influence toward the induction of one or more of the following effects, viz.:

First, increased elimination, as by diuresis, diaphoresis, and purging.

Second, dilution of the body fluids, whereby the effect upon the nerve centers of a toxin in the circulation would be lessened, as by increasing the amount of water ingested, milk diet, etc., and by bleeding, which secures practically the same result as far as the toxin is concerned, but in another way.

Third, as bearing more particularly upon the question of whether or not the toxin is a *sub*-oxidation product, lessening the amount of metabolic elaboration demanded of the trophic nerve centers, as by restriction of the nitrogenous ingesta.

Fourth, stimulation of metabolism, which, in this connection, means oxidation, by the administration of iron and other general tonics and the prescription of judiciously regulated exercise.

Another fact bearing upon this point is the well known evil effect upon the victims of Bright's disease of administering any agent which exhibits a tendency to check oxidation or metabolism, as alcohol, coal-tar derivatives, etc.

We find, then, that Bright's disease is a condition characterized by, and the clinical phenomena of which are probably due to, severe systemic toxæmia of some sort, and that the toxin concerned is probably a sub-oxidation product which would normally be elaborated into urea.

Therapeutic Indications.

The objects of treatment in Bright's disease, as indicated by the clinical phenomena and what is known of the pathology, would be, then, to secure

First, an increase in vigor in the functionation of the deep trophic nerve centers, impairment of which is probably responsible for the presence in the body of toxic products of imperfect metabolism.

Second, a direct increase of the oxidation processes in the body, whereby it will be possible to elaborate the chemical structure of the toxic bodies to a point which will admit of excretion without irritation; in other words, to oxidize them into urea.

Third, to secure as active an elimination as possible, in order that the system may be relieved of as much of the toxin as possible in the shortest possible time.

General Application.

Theoretically, this procedure should constitute an ideal therapeutical measure in connection with Bright's disease; it apparently satisfies all three of the indications for treatment.

Practically it does not prove to be as profoundly and uniformly curative as might be expected from its physiological action, but even under such limitations it is the most effective and satisfactory remedy now at our command, especially in acute cases and exacerbations of the chronic form.

In cases characterized by large amounts of albumin in the urine, and deficiency in the urea output, the former constituent lessens markedly soon after the treatment is inaugurated, and the latter is increased sometimes one hundred per cent. during the twenty-four hours succeeding the first application. In chronic cases, exhibiting a practically normal urea output, no increase in this excretion, and no very marked or immediate diminution in the quantity of albumin, may be apparent, but the evidences of toxæmia, such as headache, dizziness, etc., usually disappear rapidly. The patient is restored to usefulness and enabled to resume his daily occupation, even when the same involves pretty strenuous application, but albumin may persist in the urine for years. Some of these cases are restored to apparently perfect health.

ILLUSTRATIVE CASES.

Case I. Acute Albuminuric Nephritis.

G. B., aged fifteen years, was brought to the sanitarium on April 6, 1904, by Dr. W. S. Randall, of Derby, Conn., at four o'clock P. M. The history of the case up to that time is quoted from a letter written me by Dr. Randall on November 9, 1904, as follows.

"I was called on February 11, 1904, to attend this boy, and found him with a high fever; forty-eight hours after a rash appeared and a diagnosis of scarlatina was made. He was given the treatment usual in such cases—tr. ferri. chlor., a gargle for his pharyngitis, and kept in a warm room under the care of a nurse. A light and easily digested diet was ordered, and an antiseptic ointment applied to the body at intervals.

"All went well, fever subsiding and patient beginning to get about his room and take more food, until about March 6th, when œdema began to show itself about his feet and ankles. Urinalysis showed small percentage of albumin, the total quantity of urine passed being small in amount, and of high specific gravity.

"Diuretics and Basham's mixture were given, which seemed to relieve the early stages, but, as the case progressed, the œdema extended up the body, involving the thighs, hips, and scrotum. Dry cups over the kidneys and sweating were freely used, and some relief resulted apparently, but still the œdema persisted, and the patient seemed to make but little headway.

"Thus the case ran along, improving somewhat, until March 27th, when it was decided to move him to his home, he having been in a boarding house up to this time. A little cough had developed, and some shortness of breath was then present.

"After his removal in a close carriage, a distance of one and a half miles, he seemed rapidly to get worse. Dyspnœa and œdema increased, marked dullness developed over the lower chest wall, and abdomen became distended. The kidneys were getting into an intensely congested state, as was shown by the presence of a high percentage of blood in the urine.

"Diuretics, saline cathartics, and heart stimulants were freely administered, with only temporary relief.

"From this time the case grew steadily worse, until, on the 5th of April, I was suddenly called to his bedside to find him suffering from extreme dyspnœa, and in such an alarming condition generally that I did not expect him to live until the following morning. I administered an hypodermic of morphine and atropine, which temporarily relieved his paroxysm, and the following day after a hurried consultation over the telephone I took him to your sanitarium for dry hot air treatment."

When this patient was admitted to the sanitarium the following conditions obtained:

Marked prostration and urgent dyspnœa, which forced him to maintain an erect sitting posture and made speech a matter of considerable difficulty, patient was coughing constantly, lips were cracked and covered with large, bloody scabs.

His pulse was 124, weak, intermittent, and irregular, mouth temperature 99.2° F., respiration 52. The body was œdematous throughout, but especially so in the legs and feet, the last mentioned members being about twice their natural size. Coarse râles were diffused over both lungs and marked dullness, almost flatness, presented over their lower portions.

He was passing a small quantity of very dark brown urine of specific gravity 1001, which contained a large amount of albumin, some cylindroids and degenerated cells, a few hyaline and many granular casts, red blood cells, and small round cells from the renal tubules.

It was, in short, a typical case of dangerously severe acute nephritis, so severe that Dr. Randall "did not expect him to live until the following morning" the night previous; he afterwards told me that he was very doubtful as to his ability to get him to the sanitarium alive.

He was given a body dry hot air treatment at once; one-tenth of a grain of calomel combined with sodium carbonate was administered every half-hour until one grain had been ingested, one-sixtieth of a grain of strychnia sulphate every six hours, and one-eighth of a grain of morphine combined with atropine was given hypodermically three times during the night. His diet was cut down to milk and beef tea.

By the next morning a diminution of the dyspnœa, cough, and œdema was perceptible, and he had slept at intervals during the night a total of five and three-quarters hours, *propped up by pillows;* he felt and was appreciably improved. As the calomel had not acted, two drams of magnesium sulphate were ordered administered every two hours until the bowels moved. At 10 A. M. his pulse was 112, mouth temperature 99° F., respiration 36.

At 11 A. M. another general dry hot air application was administered; at 4 P. M. the bowels moved loosely and freely, and at 5 P. M. one-fortieth of a grain of strychnia sulphate was administered, the preceding dose having been given at midnight. The improvement in the symptoms noted in the morning had increased during the day, the patient now being able to *recline upon his bed* propped up by pillows. A noticeable decrease had also obtained in the dullness over the pulmonary areas and in the number of râles audible.

The urine passed during these first twenty-four hours measured two pints, of specific gravity 1001, color very dark brown with coffee-grounds sediment, and it contained a large amount of albumin, numerous casts and red blood cells.

To make a long story short, this patient was under treatment *one week*, during which period he was given four general dry hot air treatments, three static induced electrical applications over and through the kidneys, and three static wave current applications to his spine. The *first* electrical treatment was given at noon of the *third* day, so that no part of the very significant modifications of symptomatology noted during the period preceding can be in any degree attributed to electricity.

After the first twenty-four hours, the only medicine administered was one-sixtieth of a grain of strychnia sulphate every six hours and magnesium sulphate in two-dram doses every two hours, when it was necessary to move the bowels. One movement a day was all that it was attempted to produce.

The diet throughout consisted solely of milk, beef tea, chicken broth, a little rice, and a small piece of stale bread once daily. From a pint to a pint and a half of

water was administered, in small quantities at a time, during the twenty-four hours.

The improvement, the inauguration of which is described above, steadily continued until he was discharged, when he went home to Derby, a distance of ten miles, on a trolley car, walking from the sanitarium to the cars, a distance of half a block. The dyspnœa and cough had entirely disappeared, and, during the last three nights of his stay, he had slept *lying down* in bed; the œdema of the lungs and effusion into the pleural cavities had entirely disappeared, and the dropsy had vanished from all parts of the body except about his ankles and feet. He was as hungry as any healthy boy of his age could be, begging for something to eat with tears in his eyes.

The urine passed during the *second* twenty-four hours measured *three* pints, as contrasted with two pints during the like period of time preceding, of specific gravity 1009, as contrasted with 1001, *two per cent.*, by volume, of albumin in place of the large amount contained in the preceding specimen, and a decided lessening in the quantity of blood and number of casts present.

That passed during the *third* twenty-four hours measured *eight* pints, exhibited a specific gravity of 1006, a trace of albumin *so small as not to be susceptible of exact determination* by the ordinary methods, and estimated at one-eighth of one per cent., and *no casts.* From this time until he was discharged the quantities passed during the successive periods of twenty-four hours varied from three to six pints, the specific gravity from 1006 to 1010, with a small trace of albumin and an occasional cast.

The progress of the case since leaving us is thus described by Dr. Randall, who thereafter had him in charge.

"After his return he was put upon a strict milk diet, given freely of water, and a tonic treatment administered. The static current was used twice a week over region of kidneys from April 30th to July 16th, 1904. The urine gradually cleared from the blood cells and albumin, and the last examination on July 16th showed no trace of either. He has remained well ever since."

Although this case constitutes very good evidence as

to the value of general dry hot air applications in acute Bright's disease, yet it by no means exhibits the almost magical changes that are sometimes producible in its symptomatology by the employment of this agent. The following is an instance in point:

Case II.

Mr. E. K., aged forty-eight years, was admitted to the sanitarium for treatment at noon, January 13, 1902. Three months previously he had begun to notice that his feet were swelling, that he was having occasional headaches, attacks of vertigo, and difficulty in breathing during exertion, but thought little of it, as he was very fleshy. The symptoms shortly increased to such an extent that he consulted a physician, who recognized the trouble, judging from his prescriptions, but did not inform the patient. He continued to grow rapidly worse under treatment, and soon after consulted another with a like absence of results as far as improvement was concerned.

Upon his admission his condition was one of great gravity. He had been unable to attend to his ordinary duties for three weeks. The subcutaneous tissues all over the body were greatly distended and fluid was present in the abdominal and pleural cavities.

Respiration was irregular, nearly impossible in the recumbent, and very difficult in the upright, positions, and ranged from thirty-six to forty cycles per minute. Pulse small and wiry, irregular, and from 100 to 115 per minute. The least exertion brought on alarming acceleration and embarrassment of both respiratory and cardiac functions. Temperature 99.1° F. Patient was profoundly prostrated. Weight, *325 pounds.* Height, five feet eleven inches.

He was passing urine with a specific gravity of 1002, which was loaded with albumin and casts. As the twenty-four hours' urine had not been collected previously to his admission, the total urea output for that period was not determinable, but as I was unable to convince myself that the quantity was excessive, the low specific gravity would indicate that it must have been considerably below the normal.

He was given a body dry hot air treatment at 4 P. M., during which he perspired as I had never seen a patient perspire before. By the time the treatment was concluded, his respiratory oppression had noticeably diminished, his pulse had increased to a marked degree in volume, and the irregularity which had previously characterized both functions was considerably less evident. The skin upon his legs and abdomen, which had previously been so tense as to threaten rupture, was *wrinkled,* the subcutaneous tissue could be felt as having softened in a marked degree, and he expressed surprise at the facility with which he could perform bodily movements, as compared with the painful stiffness and sense of distention which accompanied his efforts before the treatment.

That night he was able to sleep considerably *lying down,* and during the next twenty-four hours the following changes were observed:

First, the respiratory and cardiac embarrassment continued to decrease, the irregularity characterizing the latter function entirely disappearing.

Second, the dropsy rapidly diminished until by night it had entirely disappeared except in the legs, and the condition of these members was by no means formidable.

Third, he was resting comfortably and took his nourishment with enjoyment.

Fourth, he had perspired more or less continuously since the treatment, and had passed *four and a half litres* of urine, with a specific gravity of *1022* as compared with the *1002* exhibited by the specimen taken before treatment, which figure indicated that about four times the normal amount of urea had been excreted during this period.

Fifth, a decrease of about fifty per cent. in the quantity of albumin obtained.

Sixth, his weight was 280½ pounds, as contrasted with 325 pounds on the previous day.

He received ten body dry hot air treatments during the next two weeks, at the end of which time he felt well enough to go home and to work, which he did, against my advice and judgment, however. During these two weeks he had improved steadily in all directions. The

albumin in the urine continuously decreased, as did also the dropsy of the legs. The specific gravity of the urine ranged from 1004 to 1014, except after the body treatment, when it sometimes reached 1020 and over. The daily quantity of urine passed ranged from 2 to 4½ litres. He began to go out for short walks after the first five days. During the last few days absolutely no dropsy was discernible in the morning, but it would appear to some extent in his legs at night, or after he had been out walking.

The other remedial measures, which were applied simultaneously with the dry hot air, were restriction of the diet to milk, junket, and cereals, for the first five days, after which eggs and milk toast were added; a grain and a half of calomel in divided doses three times during the two weeks; general static electrical applications, once daily; and during the last four days of his stay a gentian and iron tonic, which he was directed to continue after he left.

I saw this patient again a year later, and although he had suffered another exacerbation in the meantime under the care of another physician, yet he was then steadily and uninterruptedly pursuing his vocation of locomotive engineer. As long as he took proper care of himself, he experienced no disability, and although some albumin was still constantly present in his urine, no dropsy or indication of the disease other than the albumin was discoverable.

Chronic Albuminuric Nephritis.

Case III.

Mr. J. H., bookkeeper, aged thirty-three years, was referred to us for treatment by Dr. Albert C. Geyser, of New York, N. Y., and was admitted to the sanitarium at noon on March 30th, 1904.

The existence of chronic Bright's disease had been accidentally discovered four months previously through an examination for a life insurance policy, and during this period the ordinary medicinal, dietary, and hygienic treat-

ment had been administered by one of the best and most widely known of New York's physicians; there could, therefore, be no doubt as to the wisdom and good judgment with which the management of the case had been directed.

During this period there had been present, with a fair degree of constancy, aching pains in the loins, frequent attacks of dizziness, and some physical weakness and prostration, by reason of which he tired easily upon exertion. These symptoms interfered, more or less, with his comfort and the satisfactory performance of the duties of his vocation, and, as no improvement obtained under the ordinary remedial measures, he sought the advice of Dr. Geyser, who recognized at once the meager prospects of improvement offered by a continuance along the same old line under the circumstances, and recommended the application of dry hot air.

According to Dr. Geyser's letter of information, he was passing, before his admission to the sanitarium, a good quantity of urine of specific gravity 1005 to 1010, which contained from *ten* to *twelve* per cent., by volume, of albumin and some granular casts.

His general condition when he entered was marked by considerable bodily weakness, frequent attacks of dizziness, sometimes two or three in a day, aching pain through the loins, and pronounced anæmia. No dropsy of any sort or degree was or had been in evidence.

He was put upon a diet consisting of one quart of milk per day, and more if he wanted it; one quart of water per day, and more if he wanted it; cereals and white meats, and later this was expanded to include red meats or fish once a day, the common vegetables and plain puddings.

During the five weeks of his stay he received ten body dry hot air applications, eleven applications of mechanical vibratory stimulation to the posterior spinal nerves, ten static wave applications localized over the spinal cord, and four localized over the kidneys posteriorly, five applications of the static induced current through the kidneys, nine general high frequency treatments administered by means of Piffard's auto-condensation cushion, and four applications of the continuous current to the entire length of the spine.

The medicines administered during the first two weeks consisted solely of magnesium sulphate in two-dram doses every two hours, when it was necessary to move the bowels; and this drug was continued p. r. n. during the whole of his stay. Alkalithia was then given in dram doses three times daily for four days, but was then abandoned because it seemed to induce some muscular weakness. One dram of the syrup of hydriodic acid and an iron and strychnia pill were then administered three times daily until his discharge.

Improvement in all directions commenced at once, and continued steadily but slowly throughout the course of treatment. During the last two weeks of his stay he had no pain in the loins, no dizziness, and his physical prostration had entirely disappeared.

The total quantity of urine passed during the twenty-four hours succeeding the first general dry hot air application measured six pints, exhibited a specific gravity of 1009, and contained a large amount of albumin (amount not quantitatively determined), granular and hyaline casts, and small round cells from the renal tubules.

That passed during the twenty-four hours ending April 11th, or two weeks after admission, measured seven and one-half pints, exhibited a specific gravity of 1009, and *two and one-half per cent.*, by volume, of albumin against the ten and twelve per cent. which obtained before treatment was commenced.

Although the specific gravities of the specimens remained the same as recorded above, yet the greater total quantity of the later specimen demonstrated that the excretion of urea was greater during the later period.

Thereafter, the total quantity passed during the twenty-four hour periods varied from six to seven pints, the specific gravity from 1009 to 1012, and the quantity of albumin from two and one-half to four per cent., by volume. Casts and epithelial cells from the renal tubes were sometimes absent from the urine for more than twenty-four hours at a time; at such times the microscopical findings were almost absolutely negative in every particular.

A letter received from this patient on August 18, 1904,

stated that he was still under treatment by Dr. Geyser, and announced his intention of visiting the sanitarium again (not for treatment, however), where he "was put back on the road to health and happiness."

Dr. Geyser wrote me under date of October 18, 1904, that the patient was "still under treatment with me, dietetic, hygienic, vibration, and electricity, each as indicated; no drugs. Urine still exhibits low specific gravity and contains the usual amount of albumin. Patient feels good, and follows his vocation as bookkeeper every day, appetite good, sleeps well, has no dizzy spells; is symptomatically very much improved."

These three cases illustrate very well the different phases and degrees of profundity, of the influence exerted by dry hot air over this disease.

They all three exhibit in common its power to increase the total urinary and urea output in cases manifesting deficiency in these excretions, to decrease the quantity of albumin voided, and to relieve the headache, dyspnœa, and other evidences of toxæmia.

Cases I and II illustrate its influence upon acute dropsy, Case II, in particular, demonstrating the striking rapidity with which reduction is sometimes effected.

Case III exemplifies its effect upon many of the more chronic forms of the affection, wherein it does not produce entire disappearance of the albumin, or restoration of specific gravity to normal, but does restore the patient to unimpaired usefulness and apparent health which, as far as our present knowledge goes, are susceptible of maintenance as long as good judgment and intelligent supervision are exercised in regulating his habits and mode of life, especially as regards the occasional administration of dry hot air treatments and dietary restriction.

Furthermore, it will be observed that each of the above described results was obtained in spite of the fact that

the patients were all under the treatment during a ridiculously short time in which to expect curative effects in an ailment exhibiting such intractability as characterizes true Bright's disease; Case I was treated for one week, Case II for two weeks, and Case III for five weeks.

Finally, that the results obtained are justly accreditable to dry hot air is evidenced by the fact that additional remedial measures, other than those which had already been and were being employed without benefit, were not combined with the thermal element until after these striking modifications of symptomatology had become manifest.

TREATMENT.

General Dry Hot Air Application.

The technique of its administration is very simple. There is usually present a high pulse tension, and, during the first treatment, the heat should be increased rather slowly, watching this phenomenon meanwhile. It usually lessens during, or immediately after, the first séance. If no undue exhaustion follows the first treatment, and it very rarely does, the application may be repeated the following day, and thereafter every second or third day.

The temperature of the first treatment should be at least 300° F., and in those succeeding it should be pushed to 350° or 400° F., and run up as quickly as the patient's tolerance will permit. By this technique is secured a sudden strong impulse upon the nerve centers, which it is our aim to influence as profoundly as possible.

The after-care of the patient is that usual to the body treatment.

Additional Remedial Measures.

Diet.—The diet should always be cut down to milk and milk only, if possible, until the toxæmia has been gotten

thoroughly under control, and should then be regulated according to the conditions obtaining in the individual case. The more water the patient drinks the better, and no fear need be entertained that it will increase any dropsy that may be present; the tendency is entirely in the reverse direction.

Clothing.—Woolen undergarments of light weight in summer, and heavier in winter, should be worn at all times by the victims of this disease. Chilling the surface of the body interferes with the emunctory functions of the skin which it is eminently desirable to maintain in as efficient a condition as possible in this disease.

Drugs.—The bowels should be kept freely open by the use of calomel and salines when any inclination towards constipation is evident, and digestive disturbances should be corrected, but aside from this drugs are very rarely necessary except as tonics, when dry hot air is being administered, and the less medicine the patient ingests the better usually.

Electricity.—Next in importance to general applications of dry hot air may be placed the static, static derived, and high frequency electrical currents, especially in the chronic forms of the disease. Gratifying reports of the efficiency of these modalities have been made by Neiswanger, of Chicago, Reed, of Philadelphia, and others in this country and Europe, and the writer takes pleasure in adding to their statements an expression of his belief in the good that may be accomplished by their administration, especially the static wave and the static induced currents. He does not, however, believe it justifiable to rely upon them or any other remedial agent to the exclusion of others that promise to influence the disease process happily. He believes that much quicker and better results can be obtained by combining several means of benefit than by the use of any one alone, and in a

disease of such gravity and general intractability it is certainly wise to give the patient the benefit of everything known to be helpful in bringing about the restoration of health.

The remarks in the section upon "Intermissions in Treatment" in the chapter on "Technique," apply with some force to the management of this disease. It will usually be found advantageous to treat the patient steadily for five or six weeks at first. The time duration of subsequent courses, and of the intervals between them, will be governed by the effect produced in the individual cases.

In concluding this subject, it will not be amiss to call attention to the fact that "Eternal vigilance is the price of safety." While many patients are apparently cured by the use of the above described remedial measures, yet the majority are merely improved to such an extent that by the conscientious exercise of unremitting care they may live for years in good health and practically unimpaired usefulness; a little neglect as regards diet, exposures, or over-exertion, however, is sometimes sufficient to bring on an exacerbation, and force the patient to undergo another course of active treatment. There are few diseases in which an eternal exercise of caution and judgment are so necessary to the continuance of the victim's life, health, and comfort, as the one which we have just been considering.

CHAPTER IX.

ARTHRITIS DEFORMANS.

Modifications of Clinical Conditions Producible with Dry Hot Air.

General Application:

First, increased oxidation of waste material and acceleration of the process of elimination through the skin, lungs and kidneys, thereby relieving the already depressed nervous functions from the further depression which would result from systemic toxæmia or the retention of sub-oxidation products in the body.

Second, an influence upon the nervous system as a whole and upon general metabolism, which is in the line of an acceleration of normal physiological function, hence is not followed by evil reactionary effects when judiciously administered, and results in a hastening of the process of recovery of impaired structures.

Third, temporary mitigation of pain frequently and a sedative influence upon the nervous system, which increases the amount of sleep and quietude procurable, hence conduces to invigoration of the nerve centers.

Fourth, the restoration to usefulness and comfort of a large proportion of the victims of this disease, who, without it, would be doomed to a painful life of hopeless and helpless crippledom.

Local Application:

This measure sometimes exhibits considerable efficacy as a pain-relieving agent, and in rare cases appears to exer-

cise some positively curative influence. As a rule, however, it does not enter largely into the management of the disease.

RATIONALE OF THERMAEROTHERAPY.

It has always been our contention that if dry hot air did nothing but relieve the agonizing pain of acute rheumatism, it would be entitled to a place in the highest rank of therapeutical agents. We have seen that it not only does this, but that it lessens, by a large percentage, the duration of the disease, and transforms rheumatism from one of the most obstinate into one of the most tractable of ailments. In arthritis deformans we are again struck by the claim which it imposes upon our respect, because of the power which it exhibits of rendering useful and comfortable many lives which would otherwise be spent in hopeless and helpless misery. This disease has been hitherto, and is now, under ordinary management, the *bête noire* of the profession.

Etiology.

Four different theories are advocated today regarding the causation of arthritis deformans.

First, that it is a definite, specific, pathogenic infection.

Second, that it is the result of systemic toxæmia, the toxins being absorbed from some chronic local infective focus.

Third, that it is a metabolic or intestinal auto-toxæmia.

Fourth, that it is the result of inefficient function of one or more of the ductless glands.

The writer has been engaged in special study of this disease during the past fifteen years and we feel that all four of the above mentioned etiological factors are active in different cases; that some cases are due to one cause and some to another. We believe that any

chronic systemic toxæmia (infectious, intestinal or metabolic) of sufficient intensity, or any departure from the normal composition of the circulating fluids which produces depression (general or local) of sympathetic trophic nerve function or interferes with local cell development, is capable of precipitating it.

Rheumatism as a Causative Factor.—It is not at all probable that the disease is "rheumatic" in its nature, although an acute attack of rheumatism in one who is predisposed may precipitate the disease. We have personally had several cases under observation which we believe to have been of such character. When such a case is encountered before the active rheumatic influence has subsided, and before the vital functions have been too much impaired to recover their equilibrium merely upon removal of the exciting cause, anti-rheumatic treatment will frequently cure the arthritis deformans by removing the rheumatism which had set up and was keeping up the trouble. If the predisposition to the disease is constituted by the lithæmic or gouty diathesis, as we believe it occasionally is, or to faulty circulatory and trophic functions from sympathetic nerve depression (insufficient ductless gland secretion, for instance), then iodide of potassium, colchium, or other drugs of a like nature will always benefit, and sometimes cure, the affection. But when the disease is not dependent upon, or precipitated by a pathological condition amenable to what we look upon as specific medication or a curable local pathological process, nothing benefits it in the least except measures directed toward improvement of the general metabolic functions, and anti-rheumatic remedies will sometimes cause an increase in the intensity of the symptoms.

"Uric Acid" may be ruled out absolutely as a causative factor. Its presence or absence, excess or deficiency, have nothing whatever to do with this problem in a causative way.

Discussion at length of the etiological and pathological aspects of the disease, however, does not come within the scope of this work* and the current theories regarding these aspects have been enumerated only for the purpose of calling attention to the fact that the cardinal therapeutic indications, as far as combating the disease process, *per se,* is concerned, are essentially identical for all four, as follows:

First, to close all possible avenues of toxin absorption by eliminating suppurative, ulcerative and catarrhal processes, carious teeth, etc.

Second, to improve the general and local nutritional processes, whereby the physiological resistance of the various tissues and the efficiency of the vital activities in general will be augmented.

Third, to accelerate the elimination of catabolic products and toxins (sub-oxidative, infectious or intestinal) which depress the vital activities.

Fourth, to correct circulatory and trophic inefficiency, a certain proportion of which may be due to faulty composition of the blood, caused by aberrent ductless gland secretion.

It will be seen that thermaerotherapy enters the problem in connection with all four indications.

DIAGNOSIS.

At the present time, unfortunately, this disease is more frequently overlooked and miscalled than probably any other to which flesh is heir. This is due to the fact that

*Those who desire to go into these subjects more fully, and those who intend to treat the disease should by all means do so, are referred to "Arthritis Deformans" by Llewellyn Jones and Peter Daniels' "Arthritis" edited by James Cantlee, both published by William Wood & Company of New York City; "Diseases of the Bones and Joints" by Goldthwaite, Painter and Osgood, published by Wm. M. Leonard of Boston; and an article entitled "Arthritis Deformans" by Nichols and Richardson which appeared in The Journal of Medical Research, Vol. XXI, pp. 142-221, for September, 1909. This last mentioned is one of the most important and valuable contributions to the literature of this disease which have appeared to date.

it has only recently been definitely recognized as a distinct disease entity, which has prevented the constant and characteristic symptoms from being studied and grouped so as to make it recognizable by physicians at large, and to the additional fact that it has hitherto been almost absolutely intractable to all known treatment, which has discouraged attempts at differentiation because of the apparent uselessness of the result, if attained. Modern therapy, however, has changed these conditions and the statement is now justified that if the victims of arthritis deformans are subjected to appropriate management at a moderately early stage of the disease, the great majority of them can be restored to useful and comfortable lives, and a large proportion of them can be restored to apparently perfect health, whereas if the disease is unrecognized, hence improperly treated, for months or years organic changes will take place in the joints involved of such a nature and degree as to render utterly impossible the restoration of normal conditions.

The attainment of an early diagnosis, therefore, is of the utmost importance, and because of this fact we shall touch briefly upon some aspects of the problem that do not come strictly within the scope of this work.

The more prominent conditions from which arthritis deformans must be differentiated are acute and chronic rheumatism; chronic synovitis; flat-foot; chronic gouty conditions; neuritis; tubercular and syphilitic joint lesions; and, when symptoms are encountered indicating that the spinal column or hip joints are diseased and constitute foci of irritation, malignant processes or tumors in the cervical, thoracic, abdominal, or pelvic regions, so situated as to involve the nerve trunks and plexuses in these locations.

When the symptom complex is complete and well developed little difficulty in diagnosis is experienced by

those who have seen much of the disease but it not infrequently exhibits a reluctance to so betray itself, especially in the early stages of an attack. Bearing in mind the following will be found very helpful in solving this problem:

Arthritis deformans should be strongly suspected, first, whenever a case of joint inflammation presents simultaneous involvement of corresponding joints on both sides of the body.

Second, whenever the maxillary articulation is involved.

Third, whenever the joints of the fingers or toes are involved.

Fourth, whenever muscular atrophy accompanies or precedes the outbreak. Rheumatism will sometimes produce atrophy of the controlling musculature by compelling disuse of the joints, but this takes place in the later stages of the attack. In arthritis deformans the atrophy sometimes precedes the joint outbreak.

Fifth, whenever a case is accompanied, or has been preceded, by local sweats, local syncope or local asphyxia of the parts affected, or of the corresponding parts on the other side of the body when but one side is frankly diseased.

Sixth, whenever trophic or pigmentary changes are apparent in the skin over, or in the neighborhood of, the affected joints, in the clavicular regions, or on the outer aspects of the forearms or lower legs.

Seventh, whenever a patient gives a history of having had, for some time preceding the outbreak, *stiffness* or *soreness* of joints immediately after awakening in the morning, *which disappeared after using the joints a little.*

Eighth, whenever a case of "stiff neck" proves resistant to ordinary methods of treatment.

Ninth, whenever a case of apparently rheumatic joint

inflammation resists thorough salicyl medication vigorously for more than a week.

Tenth, if endocarditis is not present, whenever there has obtained a history of repeated attacks, the patient meanwhile having been under good general management.

Rheumatism is the disease with which arthritis deformans in its early stages is most frequently confounded, and in this connection it is important to remember that active arthritis deformans is frequently ushered in by an acute attack of joint inflammation accompanied by general febrile reaction, which subsides without leaving any apparent traces in the joints, and that an early diagnosis of rheumatism when the disease is really arthritis deformans, and management based upon this diagnosis, are responsible for most of the pitiable spectacles so frequently presented to us by victims of this direful ailment in its later stages.

It will also be helpful to study briefly the individual symptoms characteristic of the disease.

Symptomatology.

The most important are as follows:

First, pain in affected joints and the nerve trunks supplying them.

Second, elevation of body temperature (not constant).

Third, general nervous debility.

Fourth, atrophy of the musculature controlling the affected joints.

Fifth, spasmodic contraction of these muscles (not constant).

Sixth, textural changes in the skin.

Seventh, pigmentation of the skin.

Eighth, a slight degree of albuminuria (not constant).

Ninth, a varying degree of general systemic toxæmia.

Pain.—The pain is of two varieties; that in the joint itself ordinarily described by the patient as "boring," "grinding," or "aching" in character when the joint is at rest, and as an excruciating "soreness" when the member is manipulated, and that in the nerve trunks from which the joint and its musculature are innervated.

The first mentioned is usually constantly present in the acute stage. At any stage it is increased by movement, or by sharply bringing the affected articular surfaces together, as by tapping sharply and suddenly the bottom of the heel of the extended leg when the hip is affected. Palpation of the affected joint provokes pain, and the firmer the pressure the greater the pain induced. Occasionally a case is encountered in old patients, wherein no pain of any sort is present while the affected member is at rest, but it is always provoked by motion.

The pain in the nerve trunks is paroxysmal, nearly always worse at night, and there is usually present in acute cases a constant, dull, aching soreness. A certain proportion of the aching soreness is probably due to pressure upon the nerve trunks from tonic spasm, which is frequently present in the muscles controlling affected joints. Portions of the nerve are usually sensitive to pressure, as in ordinary neuralgia or neuritis.

It is well to remember in this connection that sometimes the earliest indication that arthritis deformans is threatening consists of a more or less generalized or, at least, a bilateral, neuritis. Such a neuritis should always lead one to suspect a pre-arthritic toxæmia, which suspicion will sometimes be verified by inflammatory outbreaks in the joint later.

Arthritis Deformans of the Hip Joint.—Either unilateral or bilateral arthritis deformans of the hip joint should be suspected in sciatica and the following painful peculiarities are characteristic of such affection of the

hip joint, as distinguished from sciaticas, due to other causes:

First, the pain appears *in the groin* as well as in the sciatic nerve. Some sciaticas will cause pain in the upper anterior aspects of the thigh but never in the groin proper unless associated with hip joint involvement.

Second, exacerbation of the pain by pressing sharply inward upon the trochanter with the leg extended in a line with the body, or by sharply tapping the bottom of the heel of the extended leg. In sciaticas not dependent upon hip joint trouble these procedures may cause some increase in the nerve pain due to the *jar* but will not give rise to the sensation of pain or soreness *in the joint itself.*

Third, inability to cross the leg upon the affected side over the opposite knee when in the sitting position, without lifting the member with the hand. This procedure will sometimes exacerbate the pain of a sciatica but the exacerbation of pain will be *in the nerve itself* and not in the hip joint proper.

Body Temperature.—The elevation of temperature varies from half a degree to two degrees Fahrenheit above the normal, very rarely more, and presents a very constant general curve, being below normal in the morning, beginning to rise about 11 or 12 o'clock, and reaching its maximum in the early evening. In severe, acute cases, especially in young patients, it sometimes reaches 103.5° F., but we have never seen an uncomplicated case in which it went above that point.

It will be observed that this resembles the temperature curve characteristic of some other diseases, notably tuberculosis, and it is not always the easiest thing in the world to differentiate mon-articular arthritis deformans from joint tuberculosis at the first visit. As a rule, however, the temperature of tuberculosis runs higher than that of arthritis deformans, its curve is more irregular, and it

reaches its maximum elevation earlier in the day. In doubtful cases the development of other characteristic signs will soon settle the question.

General Nervous Debility.—The nervous debility does not differ from that due to other causes, except in its profoundly trophic character and can always be demonstrated as having preceded by some weeks or months the development of the characteristic symptom complex. The tendon reflexes are somewhat increased usually; the secretions of the digestive-ferment-producing glands are impaired, and departures from the normal, both gastric and intestinal, are in evidence. Sleeplessness, sometimes from pain, but also sometimes from pure irritability of the cerebral centers, is occasionally a troublesome symptom. As a rule, however, patients nap sufficiently during the day to make up for what they lose during the night.

Muscular Atrophy.—Atrophy of the muscles controlling the joints is a very constant phenomenon, and is usually accompanied by tenderness of the same upon pressure, as in pinching.

Muscular Spasm.—A frequent cause of pain in cases wherein the larger joints are affected is spasm of the controlling musculature occurring during sleep. As soon as the patient relaxes into sound slumber he is awakened by excruciating pain, and finds the affected muscles strongly contracted. This condition is sometimes sufficiently persistent to prevent securing the necessary amount of sleep, and the victim becomes so fearful of the agony of awakening that he is afraid to attempt to go to sleep. In some cases these contractions occur during the waking hours as well.

When the cervical vertebræ are involved, profound, persistent and very painful torticollis may be produced, and sometimes this condition may remain for years after all other signs of the disease have disappeared.

In cases exhibiting obstinate torticollis it is very important to ascertain whether or not malignant disease presents in the patient's past history, as metastases in the cervical spine or its immediate neighborhood will produce this symptom at times and it may be indistinguishable from that produced by arthritis deformans. We have known such metastases to occur twelve years after extirpation of a mammary cancer in a man, and the patient be treated for arthritis deformans of the cervical spine for two years. The diagnosis of metastatic carcinoma was confirmed by autopsy in this case.

When the maxillary articulation is affected masseteric spasm is frequently a very troublesome factor; we once had a patient affected with such a lockjaw, whom we were obliged to feed upon liquids only, through his teeth, for two weeks. More or less limitation of the masticatory movements is always present when this joint is affected. Involvement of this joint, by the way, is a very characteristic phenomenon in this disease; it occurs with the utmost rarity in other diseases from which it might be necessary to differentiate arthritis deformans.

Persistent muscular contractions, such as accompany cerebral paralysis, are present in some cases exhibiting severe acute features, and in *most* of the old chronic cases.

Skin.—The textural changes resemble the "glossy skin" seen in some diseases involving impairment of the function of peripheral nerves. Sometimes the affected area does not exhibit any difference in color from that of the normal integument, but it has a peculiar dry, smooth, soft look and feel, like satin.

Cases are also met with in which the skin about the lesions, and sometimes over the whole body, looks and feels greasy and is covered with perspiration almost constantly. This condition is also encountered in other tropho-neuroses.

The characteristic pigmentation of the skin occurs as maculæ, varying in size from that of the head of a pin to that of a quarter of a dollar, the small sizes predominating. They are irregular as to outline and resemble the freckles seen upon elderly people, or "liver spots," more than anything else. They differ from these, however, in possessing a characteristic yellowish-brown, dirty look, which is easily recognized by an experienced observer, and also in that they are not confined to those parts of the body which are habitually exposed to the light, as is the case with true freckles. They usually are most in evidence on those portions of the skin contiguous to the affected joints, but may frequently be found also upon remote parts of the body, particularly the back, abdomen, extensor surfaces of the limbs, and about the clavicular regions.

We have rarely failed to find this peculiar pigmentation present to some extent in this disease, and although it is frequently present in individuals who are not so afflicted, yet have come to regard it, when taken in connection with other symptoms, as one of the most valuable of the differential signs.

Albuminuria.—The urine of arthritis deformans very frequently contains a trace of albumin, probably due to renal irritation from intestinal toxæmia or the excretion of products of faulty metabolism, as it usually rapidly disappears under body dry hot air treatments.

We have never observed casts in uncomplicated cases.

Joint Appearances.—Nothing has been said about the external appearances of affected joints, because they do not possess any value as differential signs in those cases where differential signs are most needed. One or more may be involved, the swelling may be diffuse or nodular, the skin over them may be shiny or dull, red, or devoid of any indication of inflammatory

action. We have simply a pathological joint, any of the appearances of which may be duplicated by several other affections, and when these other affections enter the diagnostic problem it is invariably necessary to go outside of the external appearances of the joint for the decisive information.

The same statement as to external appearances applies to the persistent muscular contractures.

After an attack has existed for some weeks, the characteristic muscular contractions and atrophy, glossy skin, and other signs previously mentioned, combine to form a picture which is hardly mistakable for anything else.

The Roentgen Ray.—X-light is a very useful diagnostic agent in doubtful cases of some standing. By it can be determined absence of cartilages which have been absorbed, a characteristic lesion of the disease by reason of which the bony surfaces are closely approximated; a very different picture from that which obtains in healthy joints (Cuts XXVI, XXVII, and XXVIII). Osteophytes, when present, are observable by this means, and bony anchylosis is usually differentiable from the fibrous variety, except when the hip or the vertebræ are in question; even then its answer is sometimes conclusive. There is also usually observable an increased porosity of those portions of the bones which are concerned in the formation of the affected joints.

Occasionally it is only by a process of careful exclusion and the closest scrutiny of the history of the case that a correct diagnosis can be reached. It can be reached, however, positively, satisfactorily, and at once, in nine cases out of ten, and no pains should be spared to secure this end, in view of the fact that the disease is no longer to be classed with those that are not amenable to treatment.

XXVI.—Changes in Joint Structures Produced by Arthritis Deformans of the Fingers.

XXVII.—Normal Finger Joints (a Fragment of a Needle Appears Imbedded in the Middle Finger Opposite the Third Phalanx).

XXVIII.—Arthritis Deformans of the Knee (from a radiographic standpoint the position of the joint is faulty, but the plate illustrates very well absorption of the joint cartilage; in radiographs of the normal knee the presence of these cartilages causes a large clear space to intervene between the patella and the articular surface of the femur anteriorly; in advanced arthritis deformans of this joint the patella appears to rest directly upon the femur as above shown).

Inconstancy of Symptom Complex.

We will close this brief section upon the exceedingly important problem of diagnosis by calling attention to the following additional facts which bear upon this point.

Although in the commonest form of the disease, which occurs almost exclusively in patients over forty, the

small joints are first attacked, and the lesions are nearly always bilateral, yet this is not necessarily the case in all forms of the trouble. An attack may commence in the larger joints, run its course, and recover without having involved the smaller joints at all; or it may be confined entirely to one large joint, as the hip for instance. Some of the severest cases are of this character.

While the onset is usually gradual, with a beginning so insidious that the patient is not aware that anything is wrong until a wrench calls his attention to the sensitive member, yet it may develop as suddenly as acute articular rheumatism, and lay the patient helpless upon his bed in a night.

When the disease attacks a person under thirty years of age, it usually involves both large and small articulations, and in these cases the worse phases of the disease and those most resistant to treatment are encountered.

ILLUSTRATIVE CASE.

That form of the disease which affects the smaller joints is common enough and familiar enough not to require illustration but the following case exemplifies very well the variety which involves the larger joints, as regards clinical characteristics and response to treatment with dry hot air.

Mrs. E. L. P., aged sixty-two years, consulted us on May 14, 1900. She had noticed a soreness coming on after walking, just below the crest of the right ilium, four months previously, which soreness had grown rapidly worse for two months, by which time it had extended so that it involved the front and inner aspects of the thigh as far down as the knee. It had continued to increase, both as to severity and extent of area involved, until at the time of her consultation with us the pain was present in the hip, groin, and front and inner

aspects of the thigh, and streaked down below the heel along the posterior aspect of the leg; her condition as regards pain and ability to move about was pitiable in the extreme. Was sleeping very poorly because of pain and muscular spasm in her thigh which awakened her frequently during the night. Suffered frequently from hot flashes and formications irregularly distributed over the body. Appetite was fair and bowels regular.

She was markedly neurasthenic, and had been so since passing the climateric twenty years previously. At this time she had also suffered quite severely from asthma, but this had disappeared after a stay in another city, and had never returned. There was no history of injury. Mouth temperature had ranged from 97° F., in the morning, to 99.6° F., at night. The extensor muscles of the thigh on the affected side had been somewhat stiff and sore upon pressure for the preceding ten months, but she had not paid much attention to the matter until the acute and constant pain had drawn her attention to the development of the disability. Had been treated for rheumatism up to this time, but without beneficial results.

Her mother had died of consumption, and maternal grandfather was supposed to have died from it. She was one of a family of eleven brothers and sisters, seven of whom were dead, and their health histories and the causes of death were negative as far as indicating hereditary taint was concerned. Father had died of dysentery at the age of seventy-three years.

Physical examination showed that the arcus senilis was well developed and that her radial arteries were atheromatous but the heart sounds did not exhibit any abnormality and the lungs were sound. There were no evidences of past or present disease in the small joints, and no tenderness was present. She was unable to cross the right leg over the left knee without lifting it with her hand. Patellar reflexes were slightly increased, especially on the affected side.

The characteristic pigmentation of the skin was present on the upper and outer aspects of the affected thigh and on the abdomen. Sensory phenomena in the skin covering the affected thigh and leg were normal. Pas-

sively moving the hip joint caused only a feeling of soreness, but smartly tapping the bottom of the right heel with the leg extended caused the patient to cry out, and firmly pressing the head of the femur inward against the acetabulum, or tapping it smartly, produced the same result. The sciatic nerve was sensitive to pressure back of the trochanter, but nowhere else, and deep pressure in the groin just outside of Poupart's ligament elicited pain. Her urine contained a trace of albumin, but no casts.

It will be noticed that the characteristic signs of arthritis deformans of the hip joint were present, viz., inability to cross the affected limb over the opposite one unaided, while in a sitting position; pain in the hip reflected into the groin; pain upon pressing the head of the femur sharply and firmly against the acetabulum; the characteristic pigment spots in the skin, and the typical slight elevation of temperature with a regular course.

She was admitted to the sanitarium for treatment May 15, 1900, four months after the acute trouble started. She was treated with the current from the high tension coil through the joint that evening, with resulting marked remission of pain, but she did not sleep well because of nervous irritability and muscular spasms in the affected thigh, which awakened her several times. The next day she was given a body dry hot air treatment, which did away with the pain entirely while she was in the apparatus, but it returned sharply an hour afterward. This was repeated every day the first week, and every other day the second week. Local dry hot air treatments failed to relieve the pain effectually, so they were abandoned and the current from the high-tension coil, which performed this office better than anything else, was substituted at least once, and sometimes twice, daily.

During the night of May 18th, she slept uninterruptedly all night, something she had not done before in many weeks, and she continued to sleep very well thereafter. The next day it was noticed that her limp was diminishing. On May 21st it was observed that the arteries at the wrist were growing softer and more elastic, and to dispose of this matter for good, we will say

here that when she was discharged at the end of three months, we were unable to observe that any atheroma was left. Finally, in this connection, we will state that a large number of cases of atheroma, at least in vessels susceptible of palpation, respond to body dry hot air treatments in this manner. It is not usual for the condition to disappear so entirely, however.

At the end of two weeks she was so far improved that she would be free from pain for twenty-four hours at a time, and could walk a short distance without bringing on a limp. If she continued walking, however, it would provoke the old soreness.

We decided to transfer her to the list of out-patients, and she returned to the sanitarium for treatment three times weekly thereafter until August 3, 1900, when we discontinued further treatment. At this time she had suffered no pain of any description for two weeks. Her progress on the whole had been fairly steady, but there would be periods of two or three days at a time when her pain and disability would return upon her, as is usually the case with these patients. They rarely continue improving steadily from day to day, but have short periods of improvement, followed by periods of retrogression, but each period of improvement reaches a little higher level than its predecessor, until the trouble finally fades gradually and entirely away.

We next heard from this patient on February 18, 1901, when she called upon us one afternoon and said that she had felt none of the previous trouble until about six weeks before, when she had suffered from a severe attack of la grippe. This had been followed by the old familiar pain, which was increasing in intensity, but not in the same place. It now involved the left hip and right elbow, and pigmentation of the skin was present in these regions and about the clavicles.

As the initiation of the process was so recent, and she was able to be about, we put her upon the out-patient list, and she came to the sanitarium for a body treatment followed by some static modality, three times weekly for the next two months. The treatments were then reduced in frequency to once a week for two months more, when she was discharged permanently. The

drugs given were the chloride of gold and sodium, arsenic, strychnia, and occasionally a short course of bismuth subnitrate and peptenzyme for slight attacks of indigestion. We kept track of this patient until she died of diabetes mellitus eight years later, but she never had a recurrence of her arthritis.

This case is instructive in several ways.

First, it is an example of pure, uncomplicated arthritis deformans of the hip joint, and exhibits a beautifully typical symptom complex of the affection when it occurs in this situation.

Second, it shows the futility of anti-rheumatic treatment in uncomplicated cases of the disease.

Third, it illustrates during the first attack the power of the body dry hot air application *alone* in controlling the disease, as the faradism used acted only, and was intended only, as a sedative.

Fourth, it exemplifies the power of the body dry hot air treatment in lessening, and sometimes apparently removing entirely, atheroma at least of the palpable arterial system.

Fifth, it is an example of the influence of acute infectious disease in precipitating a relapse, or, if you please, a new attack.

Sixth, it exhibits the influence of the current from the high tension coil in temporarily alleviating the pains of the disease when other means are inefficient. Usually the static current is the most effective for this purpose, but, as has been previously stated, faradism, or the high frequency current, gives better results in rare cases.

It has been attempted to divide cases of arthritis deformans into two classes; those exhibiting atrophy of the joint structures, and those exhibiting hypertrophy, as exostoses, etc. This attempt has apparently been engendered by the thought that these two types,

if they could be proved to exist, might be differentiable etiologically. The cases that have so far come under our observation have not led us to believe that such a classification is practicable; many of them exhibit the typical atrophy in some joints and the typical hypertrophy in others, during the same attack.

TREATMENT

It is only within a very few years that systematic efforts to evolve a special therapy for this disease have been attempted, largely because, as already stated, it has been only a few years since our knowledge of the affection has been sufficient to render possible a positive diagnostic differentiation in a large proportion of cases. For this reason textbook literature upon its therapeutics is meager and very unsatisfactory when subjected to the test of clinical application. As the belief that in it we have a distinct disease process exhibiting a characteristic symptom complex has gained ground, however, investigation has been directed more and more toward ascertaining what therapeutic measures are logically indicated by its clinical phenomena, and in what degree such deductions as to therapy are confirmable by clinical application. As a result, evidence is accumulating which indicates that modern therapy is capable of producing curative results in many cases, and marked amelioration of the symptomatology in a large majority of them; that arthritis deformans is about to be rescued from the category of hopelessly incurable diseases.

We may preface our consideration of the subject of treatment by the flat statement that any measure or remedy that tends, inherently or indirectly, toward repeated or sustained depression of the vitality of the individual is to be unqualifiedly prohibited. The treat-

ment of the disease resolves itself into applying those measures which will best satisfy the four cardinal therapeutic indications noted at the close of the section on "Etiology," (page 192), the relief of pain, and the management of the affected joints.

It should be emphasized, at this point, that good results cannot be attained in the treatment of this disease unless each case is studied exhaustively and conscientiously by itself. Different patients exhibit wide variations in symptomatology, and strict therapeutic individualization is frequently necessary.

Dry Hot Air.

The General Application.—The temperature should usually not be less than 350° F. As atheromatous arteries are commonly met with in these patients, it may be necessary to give less heat during the first two or three treatments until the arteries have softened some, but 350° F. can be attained safely afterward. The guide is found in the circulatory phenomena, as described in the chapter on "Technique."

Sometimes the first treatment cannot last more than fifteen minutes, and the requisite rise in temperature and pulse cannot be attained, but as the arteries begin to regain their elasticity the response is more and more kindly, until finally the proper amount of influence upon the nerve centers can be induced.

The toes of patients with this disease are very liable to suffer from the heat during the treatment, and if the apparatus is not so constructed as to permit of the feet being excluded from its interior, it will frequently be found necessary to bring into play all the maneuvers described in the chapter on "Technique" for the relief of the condition.

Efficient treatment of these cases will sometimes take

an hour, but the degree of response which means efficiency must be reached or the patient will not get his due in the way of benefit. The mere induction of perspiration, however profuse, as has been stated on a previous page, does not mean that the treatment has been properly completed. The requisite rise in temperature and pulse-rate and a marked dilatation of the facial capillaries do.

In this disease, again, it is particularly necessary to apply the higher degrees of treatment intensity and to run the heat up quickly, so as to secure the necessary degree of physiological influence as rapidly as possible. By this method we secure a profound stimulation of physiological function, which is what we desire to effect, whereas if the patient is treated for long periods with the lower degrees of heat, the ultimate result is likely to be relaxing, depressing, and pernicious. The distinctions drawn between the effects of the different methods of applying heat and dry hot air body treatments in the chapter on "Physiological Action" apply with force in connection with this disease.

The Local Application.—As has already been intimated this measure does not constitute an important element in the management of this disease. As it is sometimes fairly efficient in relieving pain, it should always be given a tentative trial when this symptom is troublesome. The technique is that usual to the treatment.

Additional Remedial Measures

Electricity.

The next most useful of the physiological agents is electricity, and the several forms of current have distinct and different spheres of influence. The one of greatest utility is that derived from the static machine,

and the wave current and the spark are the most frequently serviceable modalities. Some authors claim to have cured cases with the static current alone, but such an instance has never come within our personal experience, and it is usually difficult enough to benefit these patients materially, even when all the resources at our command are brought into action.

The Static Current.—During the acute stage the wave current may be applied to the affected joints twice daily by means of sheet tin electrodes moulded to the parts, and this modality is frequently very effective in relieving pain. The influence of every static application is general as well as local, no matter how the treatment is localized, and the effect upon the organism at large is often happy to a degree.

The brush discharge from the wooden or carbon electrode applied to the affected part for fifteen or twenty minutes is effective in relieving the neuralgias as well as the aching pains of the acute condition, in a certain number of cases.

Sparks may be applied over the spine and general muscular areas of the body for their tonic effect at any stage of the disease, but, as a rule, they had better not be applied to joints wherein acute symptoms are manifest. When the acute process has subsided, however, and the local phenomena have become confined to soreness and fibrous enlargement, we know of no measure which will so frequently prove effective in removing both as judiciously applied static sparks.

The various neuralgias which accompany the disease are also amenable, as a rule, to the static spark.

The static wave current localized over the solar plexus and abdomen will sometimes give excellent results in the gastric and intestinal indigestions, which are frequently quite troublesome.

The High Frequency Current.—The general application of the high frequency current, two or three times a week, in the late afternoon or early evening, by means of the spiral wire cage of d'Arsonval or the auto-condensation couch, is very helpful through its tonic and sedative influence upon metabolism and the nervous system, and sometimes induces sleep in patients who are obstinately wakeful.

The high frequency current applied to diseased joints by means of the glass vacuum electrode is fairly effective in relieving the pain, and has also seemed to me to exercise an appreciable amount of influence in removing local pathological conditions.

The Continuous Current.—This modality, in the form of central galvanization, positive polarity active, negative dispersing electrode over the solar plexus, is very helpful in improving the patient's general condition and as a sedative to the nervous system, but I have never been able to secure any local effects with it upon the joint conditions that I could not have secured just as well, and usually better, with something else, whether the current volume was weak (5 ma.) or strong (75 ma.), except in muscular spasm due to nerve irritation; in the torticollis of arthritis deformans the continuous current in doses of from 5 to 20 ma. for fifteen minutes, will sometimes give more satisfaction than anything else as regards relief of both pain and spasm.

In applying central galvanization, the brain is treated first, and it should be remembered that great care must be exercised when using this current upon this region of the body. Beginning with the current at zero, it should be increased gradually, diminishing the volume immediately if dizziness, faintness, or nausea obtain; it is very easy to throw a patient into syncope during this operation. Usually from 3 to 5 milliamperes for

three or four minutes will be enough. In the cervical region the milliamperage may be increased to from 5 to 15, according to the patient's tolerance, for five minutes. The dorsal and lumbar regions may be treated for five minutes each, and as no dangerous symptoms are to be feared in these vicinities, the current volume may be increased until the cutaneous sensibilities revolt, which occurs ordinarily at from 20 to 30 milliamperes.

It has been stated that the soreness in the joints may be relieved by treating them with weak galvanic currents, positive polarity, using a hot-water bath in which the affected members are immersed as the active electrode. Although we have tried this repeatedly, we never have been able to convince ourselves that any other benefit resulted than would be produced by the hot water alone without the current. It is unquestionably greatly inferior to the static modalities, faradism, and dry hot air in this situation.

The Magnetic-Induced Current.—This current plays very little part in the treatment of arthritis deformans when a static machine is available, but when it is not a good high tension coil is very useful as a temporary sedative.

The current is passed directly through the aching joints with a strength as great as is consistent with the patient's comfort, and the relative positions of the polarities is usually a matter of indifference. In the form of spinal and general faradization, it exercises a very helpful influence upon the nerve centers and general metabolism, and in rare cases it will be found that the coil gives sedative results in this disease superior to those produced by the static modalities or dry hot air. It may be applied as often as pain demands it without injury to the patient.

Hydrotherapy.

The effect of the hot and cold douche to the spine, and to joints in which the process is not active, is frequently very gratifying in this disease. The circulatory and nutritional functions are noticeably augmented, and considerable influence upon the local pathological condition is often observable. The water should be applied by means of a hose, and the duration of both hot and cold applications, and the pressure at which it is delivered, must be regulated according to the reactive susceptibility of the individual patient. A marked reaction must be obtained if material curative results are to follow.

Mechanical Vibratory Stimulation.

This remedial agent is undoubtedly a powerful general tonic. It will relieve the pain of muscular spasm and relax the spasm more effectively than any other measure with which I am acquainted except anæsthesia, and it is powerfully and harmlessly sedative to the irritable nervous system. In both of these capacities it enters logically into the management of arthritis deformans and will be found practically of decided value and assistance.

Massage.

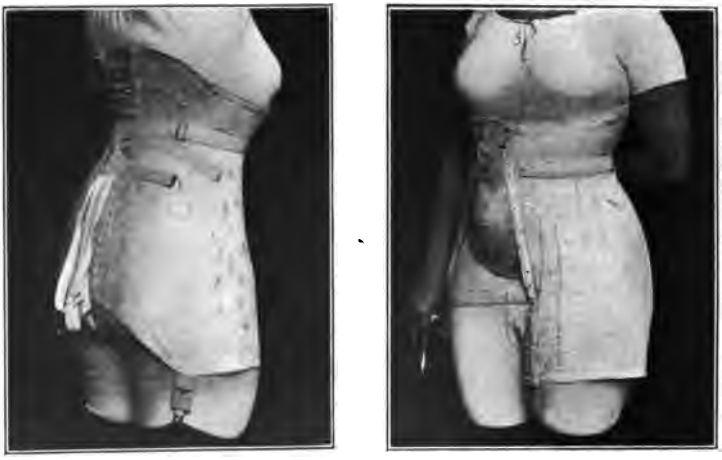
Massage, either general or local, will very rarely have to be considered in the treatment of this affection when the agencies already mentioned are available. When they are not, however, it will be found useful in relieving pain, locally, and in improving the patient's condition generally.

Support of Sagging Abdominal Viscera.

It is a well-known fact that abdominal viscero-ptosis frequently results in obstructing the passage onward

through the bowels of fecal matter, thus producing intestinal absorption and toxæmia. Now intestinal toxæmia is generally considered to be one of the causes of arthritis deformans, hence sagging abdominal organs in these cases should always be supported.

The ordinary abdominal supporter is not very efficient for this purpose. It squeezes the abdomen inward but does not lift it upward satisfactorily.



XXIX.—The Ludington Corset-Supporter for the pendulous abdomen.

The most efficient device for supporting the pendulous abdomen that has come under our notice is a combination corset and supporter devised by Dr. Nelson A. Ludington of New Haven and made by the Clara Moore Corset Company, also of New Haven, from which firm it can be ordered for any patient by filling out a proper measurement blank sent upon request. It consists of a specially constructed corset with slits on each side, just in front of the spines of the ilia. A specially shaped pad fits

over the sagging abdomen inside the corset. From each end of this pad belts about an inch in width made of strong, inelastic fabric pass outside of the corset through the previously mentioned slits and upward around the back and the opposite sides, fastening to a little button on the front of the opposite half of the corset just below the level of the breast. These belts are adjustable as regards their length so that any degree of "lift" can be secured by shortening them.

In some cases auxiliary belts are required as shown in the cut.

As the corset is carefully adapted to the anatomy of the patient, and the supporting mechanism located inside of the corset, it can be worn without betraying its presence as far as the patient's appearance is concerned, and with perfect comfort by the wearer. It can be worn with an evening gown as well as with anything else.

This convenient and very elegant device has proven to be entirely satisfactory, in our practice, as an abdominal supporter. We are applying it to all of our women patients who exhibit abdominal viscero-ptosis.

Bier's Hyperemia.

Artificial hyperemia by the constriction and cupping methods has never given us any help in connection with any phase of this disease that we could not have secured just as well with something else, and we have practically abandoned its use in the treatment of it.

Dietary Regulation.

Proteids.—Absorption of putrefactive toxins from the intestine is held by some observers to be a dominant etiological factor in this disease, and no one disputes the fact that such absorption is depressing in this or

any other condition. The prevention of intestinal putrefaction is, then, desirable, and this can best be accomplished by temporarily excluding from the diet those foodstuffs in which putrefactive bacteria are most active. These are meat, poultry, and fish. When these are excluded, however, care must be taken to see that sufficient protein material is supplied by other foods, and milk, eggs, nuts, and gelatin usually take the place of flesh very satisfactorily as far as the nutritional needs of the body are concerned.

Flesh should always be excluded, at least temporarily, when indican is present in the urine, and it will sometimes prove beneficial to exclude it even if intestinal putrefaction is not demonstrable. Aside from this, however, the diet should be as generous and as nutritious as is compatible with thorough digestion and assimilation.

In some rare cases milk and eggs are not absorbed readily and in these cases enough casein and albumen may reach the colon to putrefy there. Under such circumstances it may be necessary to exclude sweet milk and eggs from the diet also.

Sour milk or buttermilk, however, almost never produce intestinal putrefaction and contain just as much proteid nutrition as sweet milk. In addition to this they contain lactic and succinic acids, which tend to inhibit the growth of putrefactive bacteria, hence the frequently repeated introduction of these substances into the bowel would seem to be a logical procedure. Decided results are easily demonstrable. A pint of sour milk, administered in divided doses during the day, will usually greatly lessen putrefaction in the bowel, even if flesh is not excluded from the diet, and when it is excluded, this quantity of sour milk will practically eliminate putrefaction.

The most effective method of administering this dietary is to limit the patient's food to sour milk and well-browned, buttered toast for a week, or longer if he will submit to it; but the average patient must be suffering a good deal before he can be persuaded to do this. From one to two quarts of the sour milk per day are required when the diet is thus restricted.

Carbohydrates.—The restriction of carbohydrate ingestion in this disease has, in our opinion, been greatly overdone. The impression has been almost universal that depressive gases from carbohydrate fermentation constituted one of the causative elements. Our personal experience since we have used the fleshless diet has led us to conclude that *when fleshes are excluded the carbohydrates do not ferment.* We have no hesitation, therefore, in permitting these patients to have any reasonable amount of carbohydrates, including sugars, *while they are on a fleshless diet.*

Alcohol.—There is considerable difference of opinion regarding the advisability of allowing alcohol in arthritis deformans. Some writers advocate it, some are indifferent, and some frankly disapprove of it. Our experience leads us to disapprove of it as a rule. We have not been able to convince ourselves that patients got along any better with than without it, and it has sometimes seemed to make the patient nervous and to aggravate the joint trouble, even when the dosage was small.

Tobacco.—Tobacco is not usually well borne by these patients, and to some it is frankly and demonstrably injurious, even in very small quantities. We have observed one case in which even two cigarettes a day would stop progress toward recovery. On discontinuing the tobacco altogether progress would be resumed. This patient was very fond of smoking, and two or three repetitions of this experience were needed before he became

convinced that it would be necessary for him to abstain. After he recovered he was able to resume the habit in moderation, but if he overdid it for two or three days in succession, stiffness and soreness reappeared in his joints; these disappeared again after forty-eight hours' abstinence.

Clothing.

In any case exhibiting more or less constant pain as a symptom, a good quality of woolen underclothing, of light weight in the summer and moderately heavy in the winter, is a source of comfort to the patient in protecting the skin from sudden changes of temperature, which are liable to increase the pain; arthritis deformans is no exception to the rule.

Protection of skin by woolen undergarments renders another service by maintaining the function of this emunctory, which is so important a factor in the general metabolism. Impairment of general metabolism is usually a prominent feature of this disorder.

Change of Climate.

A temporary or permanent change of climate is frequently productive of a certain amount of benefit in this as in other debilitating diseases, but so much more benefit is usually obtainable by the means we are discussing, without change of climate, and so few of the victims of this disease are so circumstanced as to make a change of climate possible, that this frequently recommended element in its management may be dismissed without further mention.

Drugs.

Alteratives and Tonics.—Medication alone is unsatisfactory as regards the securing of curative results. No

substance has yet been discovered which exhibits a specific curative action as far as the disease, *per se,* is concerned, but there are a few medicines which appear, in some cases at least, to exhibit considerable influence over the condition. All of them, with the exception of thyroid, thymus and the salicylates, belong in the tonic and alterative classes, hence produce their beneficial effect by means of their power to influence general or local metabolism. Prominent among them may be mentioned the iodides, cod-liver oil, the hypophosphites, arsenic in its various combinations, strychnine, and the chloride of gold and sodium.

The iodide of iron and iodide of sodium have given me the best results. The iodide of iron should be selected for anæmic cases but I know of no other differential indication. Whichever is selected should be given for periods of six weeks, with intermissions of two or three weeks.

Cod-liver oil does good service in cases characterized by emaciation, if well borne by the stomach.

Arsenic and strychnine are very useful, in many instances, as general tonics.

Chloride of gold and sodium and hydriodic acid sometimes seem to render considerable service, but they fail to influence the disease in such a large proportion of cases that their importance is not nearly so great as is generally supposed.

Thyroid and Thymus Glands.—The beneficial influence which these substances have exercised in some cases of this disease is particularly interesting, because of the possibility that aberrent function of ductless glands may be concerned, to some extent at least, in its etiology. R. Llewellyn Jones, of Bath, England, whose work on arthritis deformans is a veritable mine of information and interest, favors the use of thyroid in

certain cases, especially when hypothyroidism is present, or when the vasomotor phenomena peculiar to the disease are prominent. He also refers to MacAlister, Lancereaux, Revilliod, Midelton, and others, as having observed good results from its administration. I have administered it to a few patients and feel that they have derived considerable benefit therefrom.

The remarkable results which have followed their administration in some cases demand that their action be thoroughly investigated.

Salicyl Compounds.—The relation of the salicylates to this disease deserves special mention, as they sometimes render excellent service in relieving pain and swelling. Although it is improbable that rheumatism is an etiological factor in any considerable number of cases, yet it is not so very rarely that an attack of rheumatism becomes engrafted upon an already existing arthritis deformans, and as the salicylates fail absolutely in so many manifestly uncomplicated cases, it seems reasonable to consider that many of those in which they are useful are instances of such a complication. The fact that beneficial influence is obtainable by their use only up to a certain point would favor this view. The difficulty of making a positive diagnosis of rheumatic invasion under such circumstances is, in many cases, of course, insuperable. Whatever the explantation, the fact remains that salicyl compounds are sometimes very helpful in relieving the painful joint conditions occurring during the course of arthritis deformans.

Laxatives.—Constipation is sometimes present in a degree to demand attention, and the various mineral waters, magnesium sulphate, the aloin, strychnine, and belladonna mixtures, or compound licorice powder will be found helpful. What particular one should be used

must be determined by the tolerance of the individual patient.

One of the most helpful agents with which to combat constipation, in this or any other condition in which mechanical obstruction of the lumen of the intestine is not a causative factor, is coarsely ground agar-agar. Four heaping teaspoonfuls of the dry agar-agar should be put into a soup plate and a teacupful of hot water poured over it and allowed to stand until it has been absorbed. This may then be flavored with sugar and cream, or a layer of cut-up fruit and sugar and cream to taste and eaten as a cereal the first thing in the morning for breakfast. This substance is absolutely indigestible and unirritating and acts solely by reason of its bulk, which stimulates the bowel to active peristalsis. It has a great affinity for water, which it is as unwilling to part with as it is eager to absorb it, whereby it prevents the intestinal contents from becoming dry and hard or lumpy.

Digestants and Anti-fermentatives.—Digestive disorders can generally be controlled by regulating the diet, but the digestive ferments, carminatives, charcoal, bismuth subnitrate, strychnine, and salol will sometimes have to be called upon to assist in this work.

Quinine.—This drug has been lauded as a remedy for arthritis deformans, but we have never been able to convince ourselves that it was of any service in any of the cases to which we have administered it, and regard its claim to efficiency in the management of this disease, *per se,* as open to grave doubt.

General Routine Treatment.

In order to get the most out of these various remedial measures, it is necessary that they be applied with intelligent system, and a routine standard is necessary as a point of departure; this can be modified to suit the

individual peculiarities of the various types of the disease, and the variations in the patient's condition from week to week. That which has given us the most satisfaction is as follows:

1. Rest in bed for at least twelve hours out of the twenty-four.

2. A diet as generous as can be digested and assimilated by the individual patient, without producing intestinal putrefaction or fermentation.

3. From 1-30 to 1-40 grain of strychnine sulphate, and 2 or 3 grains of ferrous iodide, three times daily, half an hour before meals, and in emaciated cases from 1 to 4 drams of cod-liver oil, after meals.

4. A dose of some one of the various mineral waters, before breakfast, every two or three days.

5. A body dry hot air treatment two or three times weekly.

6. Central galvanization once or twice weekly.

7. A general application of mechanical vibratory stimulation two or three times weekly.

8. A static electrical application at least once every day, consisting in acute cases of the Morton wave current localized over the affected joints or spine, and in the chronic cases of long, thick sparks to the affected joints one day, and the Morton wave current localized over these joints the next. In some cases, some one of the high frequency currents, applied either locally or generally, may advantageously replace some of these static applications or be added to them.

9. A hot and cold douche to the spine two or three times weekly.

This scheme can be added to or otherwise modified so that the emphasis of the weekly schedule can be laid upon any measure which may be predominantly indicated in a given case.

Intermissions in Treatment.

The advantages contingent upon temporary suspension of treatment, which are suggested in the section upon "Intermissions in Treatment," Chapter III., are sometimes very noticeable in arthritis deformans. Our custom is to keep the patient at the sanatorium for six or eight weeks, or until he has improved substantially, for the first course, and then send him away for a month; he then returns to the sanatorium for three or four weeks more, after which he is recommended to go away again. The time duration of the courses of active treatment, and of the intervals between them, will, of course, have to be governed by the conditions surrounding the individual cases as regards the degree of improvement attained, etc.

Relief of Pain.

One of the most troublesome symptoms in severe cases, as regards management, is the constant, harassing pain in the joints and nerve trunks. The majority of these patients have become so habituated to pain that they bear a moderate amount without much complaint, but sometimes severe exacerbations will occur, lasting for hours, days or weeks, which demand attention. The remedial measures already discussed will, in the course of their application for the condition, *per se,* eliminate a good deal of it, and as the disease improves, the pain lessens proportionately, but the pain of these exacerbations frequently demands direct and immediate relief.

Physiotherapy.—Among the physiological measures we have already mentioned static, high frequency, faradic, and galvanic electricity as being more or less effective in this condition; to these should be added dry hot air, the electric arc and incandescent lights locally applied, the hot water bag, and hot fomentations. In some cases,

an ice-cap or piece of flannel wrung out of cold water wrapped in three or four thicknesses about the joint and covered with oiled silk, will give more relief than anything else.

Drugs.

External Application.—Baume analgesique (Bengue), the old familiar chloral, camphor and aconite mixture, and the tincture of iodine externally, have given us good results in some cases.

Internal Administration.—If physiological measures and external applications fail, the internal administration of drugs must be resorted to, and by reason of the inefficiency of those permissible, this subject may be dismissed very briefly. Opium, or any of its derivatives, is inadvisable because of the chronic character of the trouble, because this drug loses its influence in a few days unless given in increasing doses, and because of its evil effects upon the system at large. We have occasionally given coal-tar derivatives, but they also produce undesirable effects upon the metabolic and circulatory functions when continuously administered in effective doses. We have, however, used salicyl compounds and pyramidon with considerable satisfaction in many cases. The tinctures of hyoscymus and gelsemium are sometimes helpful in relieving the pain, in the nerve trunks particularly.

When the pain is due to spasm of the controlling musculature, occurring during sleep, strontium bromide in 20 or 30-grain doses, repeated hourly until the condition is relieved or until three doses have been taken, will usually give good results, and patients stand its continued administration, according to our experience, considerably better than they do that of the sodium and potassium salts.

A mechanical procedure which frequently proves helpful in this condition consists of bandaging the affected muscles snugly (not tightly enough to interfere with the circulation) when the patient prepares for the night. This will sometimes prevent the spasm from occurring at all.

Management of the Joints.

During the acute stage the joints should be kept at rest. We do not mean such complete rest as would necessitate enclosing the member in a splint, but the patient should be directed not to use the joints to such a degree as to produce much pain. They are sometimes urged to force the joints to functionate, no matter how exquisite the anguish induced, in order to "keep the joints from stiffening." Such advice is pernicious in the extreme. If the conditions in the joint are such that ankylosis is threatening, the irritation produced by the laceration and contusions which follow forced function, will hasten its onset and intensify its degree.

Ankylosis.—The ankylosis of this disease is divisable into two primary classes: one in which muscular spasm is the predominant etiological factor, and another in which structural joint changes are responsible for the loss of function. These two conditions are present in varying proportions in different cases, and it is sometimes impossible to say at first which one is most active in a given case.

The first named variety is frequently present in acute outbreaks, disappears as the general disease process improves, and, if the joint structures have not been extensively altered, restoration of function will ultimately be complete. The only local treatment needed is to keep the joints at rest or at least to eliminate degrees of motion sufficient to cause much pain, and the application to the

joint of static sparks, the high frequency current by means of the glass vacuum electrode, the electric arc light, dry hot air, and the hot and cold douche of an intensity and under a pressure suitable to the individual patient.

The second variety consists of a later development of the conditions involved in the first mentioned, and produces some of the gravest problems presented by the disease. The pathology of arthritis deformans is not well understood as yet, but a study of such autopsical observations as are available, demonstrates that the factors to be reckoned with here are (1) fibrous adhesions between the contiguous joint surfaces which have resulted from degeneration of the synovia and cartilage and overgrowth of periarticular structures, and (2) true bony union where the denuded surfaces of cancellous bone have been brought into contact by absorption of cartilage and the synovia.

In the hypertrophic form the interlocking of osteophytes sometimes produces ankylosis.

Treatment of the two last named forms may be dismissed in one sentence: nothing but a cutting operation offers any hope of relief. Fortunately, true bony union and exostotic ankylosis are not very common.

Careful consideration is necessary, however, in the case of fibrous adhesions and periarticular overgrowth. The first procedure which comes into one's mind is the forcible breaking down of the adhesions. Such manipulation is followed by good results in the ankylosis due to confinement of a joint in a splint, and in that resulting from infectious processes in many cases. It would seem to be logically indicated in arthritis deformans, but, unfortunately, clinical experience proves that pernicious results usually follow its adoption in this disease. Motion may, indeed, be restored to the joint temporarily, but as time goes on the ankylosis returns, and the last con-

dition of the joint is worse than the first; complete ankylosis eventually takes the place of that which was at first only partial.

Just why this measure does not produce the same permanent and happy results in arthritis deformans as in other apparently more or less analogous pathological conditions has not yet been satisfactorily cleared up, but a possible explanation is suggested by the contention of Painter, Hoffa, and others, that the histological phenomena presented by the joint changes in arthritis deformans are those of degeneration rather than inflammation, which is to say, that the reparative and absorptive powers of the joint structures are greatly impaired in this disease. This being the case, the débris resulting from forcible breaking down of adhesions could not be properly disposed of, and the traumatism not being susceptible of normal repair might, through the irritation induced, result in the formation of more fibrous tissue and, ultimately denser adhesions. Indeed, one can easily conceive that areas of bone might actually be denuded of their cartilage and true bony union facilitated thereby.

Whatever the explanation, the fact remains that sudden, forcible breaking down of the ankylosis of arthritis deformans, when it exists to any great extent, is very rarely followed by anything but evil and pernicious results, should never, under any circumstances, be attempted while the disease manifests any active tendencies, and only in a cured case after the most careful consideration of the conditions surrounding the individual patient.

After the acute process has subsided, however, judiciously regulated, gradually increased movements of the stiffened joints, both active and passive, are productive of much benefit and, frequently, partial ankylosis can be entirely removed thereby. Neither active nor passive movements should be carried to the point of exciting

much pain, and if soreness or stiffness are aggravated, it may be looked upon as an indication that the movements are excessive.

The physiological measures useful in treating the first mentioned variety of ankylosis are just as useful in connection with the graver forms.

RELAPSES.

Cases of arthritis deformans are very apt to relapse during the first year after recovery. A very common cause is an attack of some acute disease of an infectious or debilitating nature, as la grippe; another is that patients who have been accustomed to an active life before the disease disabled them are so elated and confident at being again in condition to do something after months, and sometimes years, of enforced idleness, that they overwork. The overstrained nerve centers yield and another outbreak obtains. In fact, anything tending to lower the general vitality is liable to result in a reappearance. It may involve the same old joints, or entirely new ones may be invaded and those affected previously escape altogether.

The victims should be gotten under thorough treatment again as soon as possible, and this should be persevered in until recovery supervenes. Under the very best of conditions recovery is a matter of months, but when we reflect that in the past we have been able to accomplish scarcely anything with any degree of certainty in *any length of time,* the possession of measures which will restore to some of these victims useful joints and comfort in living is a matter upon which we may most sincerely congratulate ourselves and our patients, however long it takes to do it. Persistence in treatment is the sheet anchor of hope for the victims of this disease.

CHAPTER X.

PERITONITIS; PLEURITIS; SYNOVITIS; NEURITIS; SCIATICA; LITHÆMIA; GOUT; NEURALGIA; MYALGIA; VARICOSE ULCERS; OTITIS.

In the preceding chapters the different phases of the physiological action and clinical results of dry hot air applications have been discussed with sufficient thoroughness to render apparent what effects may be expected to follow their use in most of the pathological conditions commonly encountered, and how these effects are produced. In the affections which remain to be considered, therefore, the subject will need to be treated but briefly.

PERITONITIS.

Varieties.—This disease is usually secondary to some other affection, as benign or malignant tumors, salpingitis, appendicitis, etc. It is also caused by tuberculous infection of the peritoneum, sometimes apparently by microbic invasion from the intestinal canal, and occasionally an instance is encountered during the course of, and seemingly traceable to the specific etiological factor pertaining to, an infectious fever.

Sphere of Usefulness of Dry Hot Air.—When peritoneal inflammation is microbic in causation and confined to the membrane itself, it will usually yield kindly, rapidly, and permanently to dry hot air; the condition, under these circumstances, may be likened to local septic infection, as far as thermaerotherapy is concerned. When

it is secondary to some other condition, however, permanent cure will necessitate eradication of the exciting cause.

One of the most prominent and harassing symptoms accompanying nearly all forms of peritoneal inflammation, except that due to the tubercle bacillus, is pain. Dry hot air will always relieve completely and immediately that proportion of it which is caused by the peritonitis proper, and, as this remedy may be applied as often as the pain recurs, the patient's comfort may be maintained indefinitely.

In salpingitis coming under treatment moderately early and before suppuration has been established, the knife will rarely be needed for obtaining control of the condition. The body treatment two or three times a week, in combination with the local once or twice daily, will usually effect a rapid and complete subsidence of the pathological process, and the writer has seen several cases recover under the local application alone. The body treatment, however, always hastens the result, and in some cases its use is imperative. The deeply seated aches and pains due to the salpingitis itself are controlled by the body treatment more effectually than by the local application in many cases.

The writer has never had the courage to rely upon the thermal agent alone for the cure of appendicitis, but Burwash of Chicago reports two cases which he carried to a successful termination with this measure only.

In tuberculous peritonitis, the occasional splendid results which have followed a simple laparotomy give ground for the belief that this agent may prove to be of benefit here. The most probable explanation of the way in which laparotomy has accomplished its effects seems to be that the absorptive power of the peritoneum, which is enormous under normal conditions, is rescued

from a temporary inhibition which had resulted in so impairing the physiological resistance of the membrane as to allow pathogenic germs to gain a lodgment and proliferate, by the operation; that the peritoneal congestion due to allowing the air or irritating fluids to come in contact with the membranes, so activates the circulation as to bring about the phagocytic destruction of the invading micro-organisms. Dry hot air possesses the power of inducing physiological congestion, hence restoration of impaired absorptive function, to a degree unapproached by that of any other measure now known, and if this is the true explanation of the effect of laparotomy, the thermal agent should be valuable in this affection.

The influence of the body dry hot air application in eliminating general toxæmia and stimulating the general physiological resistance, is as marked in this disease as elsewhere, is always of great assistance in securing a favorable termination, and in many cases constitutes the measure most to be relied upon.

Illustrative Case.

It was the results following its employment in a case of acute peritonitis that first suggested to the mind of the writer that dry hot air might be useful in pathological conditions other than rheumatic ailments and traumatic joint affections. The case was reported in the New York Medical Journal in 1899, and is such a striking illustration of the splendid results sometimes obtained by the use of thermaerotherapy in this disease that we quote it from that periodical as follows:

"Miss L. L., waitress. Was called to see the patient at 2 o'clock a. m., November 8, 1898, and found her suffering with severe colic. She had been feeling poorly and suffering from slight cramps in the bowels for a

week past. Abdomen was tense and tender, this last being especially marked in the left iliac fossa. Bowels had been constipated during the preceding week. Pulse, 72; temperature per mouth, 98.6° F. I made a provisional diagnosis of colic from indigestion and constipation, but as patient was living in illicit relation with a man about town, and as I had previously met with some trying surprises in the way of abdominal inflammations during my practice, I decided to call again and watch her progress. I administered morphine, a quarter of a grain, and ordered magnesium sulphate in teaspoonful doses hourly, to be begun in the morning and taken until bowels moved, then discontinued. Patient was comfortable, so far as pain was concerned, in half an hour, and I returned to my couch and resumed my interrupted slumbers.

"Same day, 6 p. m.—Found patient suffering acutely from severe cutting pains all over the abdomen; pulse 106, temperature 100.5° F. Abdomen tense, acutely sensitive to touch, but focus of tenderness still remained in left iliac fossa which region was entirely intolerant of manipulation. I was unable to find anything specific in the neighborhood of the appendix, changed my diagnosis to gonorrheal salpingitis and peritonitis, and was glad that I had called again. Morphine had controlled pain pretty well for four hours, after which it returned and continued with increasing intensity up to the time of my visit. Magnesium sulphate had produced two small thin movements, accompanied by sharp pains. I made up my mind that I was in for another of the harassing experiences which go to make up the ordinary management of these cases, ordered that flannels wrung out of hot water be constantly applied to the abdomen as hot as could be borne by the patient, gave her another hypodermic, left her two quarter-grain morphine pills to be taken in case the pain became unbearable before my next visit, and put her on an exclusive milk diet.

"November 9, 12 m.—Patient had been suffering intensely since midnight. Knees were drawn up, abdomen much distended, unable to make the least movement without provoking excruciating agony, which was also occasionally exacerbated by attacks of retching; she was

shivering and her teeth were chattering from the exhaustion due to long-continued suffering. Pulse 104, respiration 28, very shallow and quick; temperature 101.2° F. The morphine pills that I had left at my previous visit had not been used, as I had requested her not to take them unless it was absolutely necessary. With the proverbial capacity of her sex for enduring pain, she had not considered that the point of absolute necessity had yet been reached. I realized that something must be done, but I hated to inaugurate a systematic course of morphine with its resultant evils, particularly undesirable in a disease of microbic origin where it is of the first importance to preserve the metabolic activities of the body unimpaired; as the hot applications were doing no good, however, it seemed the only measure capable of dealing with the situation.

"While I was considering, the attendant came to the bedside to renew the hot application. The patient looked up at her and exclaimed, 'Oh, is it very hot?' Upon being assured that it was, she remarked, 'The hotter you get it the better it feels.'

"Like a flash my dry hot air apparatus rushed into my mind. With it I could apply a heat of 500° F., whereas the flannels could not be used at more than 160° F. I asked her if it was true that the greater the heat the greater the comfort she experienced. She answered that if the flannels were not very hot they gave her no relief at all. A small ray that was hardly strong enough to be hope brightened the darkness. If 160° F. of heat gave her some relief from pain twice or three times that might give her a good deal, and by frequent repetitions I might be able to avoid the morphine. The prospect was worth the experiment. I told her that I would try something else in the afternoon, and did not administer any morphine.

"At 4:30 p. m. I applied dry hot air locally over the abdomen with doubt, fear and trembling. My gratification can be better imagined than described when, at the end of ten minutes, the sufferer's face relaxed its pain-distorted lineaments. In thirty minutes she looked up at me with a quiet smile, saying, 'Oh, how good that feels!' and in forty-five minutes, while still under treat-

ment, she had fallen exhaustedly asleep for the first time in thirty-six hours.

"At the conclusion of the treatment the patient expressed herself as being entirely free from pain while she kept still, but when she moved it was still there, and manipulation was as little tolerated as before. I left the apparatus there, directed that I be called immediately when pain returned, and departed walking upon air because of the result achieved. I expected, of course, that a repetition would soon be necessary. However, I had been able to give her a relief so perfect that even morphine would have been inadequate for its accomplishment, and by withholding the drug had been able to preserve her mental and physical functions unimpaired. If I could keep this up I would be willing to treat her every hour, if necessary. The hours wore on, and to my growing astonishment I received no summons until, by the following morning, I began to fear that another physician had been substituted for me without the formality of my discharge having been observed. I found it difficult of belief that the treatment could have produced results so happy and so long continued.

"10th, 12 m.—Patient greeted me smilingly, reporting that relief from pain had continued complete until nine o'clock the preceding evening, when, for about fifteen minutes, she suffered from slight cramps. At midnight she had severe cramps for an hour, but none since, and to make a long story short, I will say here that those were the last pains she suffered. The abdomen was relieved of its distention, tenderness upon pressure had entirely disappeared from the right abdomen, but was considerably in evidence in the left, and very much so in the umbilical region and below from manipulation of which area she shrank in terror. Bowels had functionated spontaneously and with little pain; she was taking milk freely and stomach was not at all irritable. Pulse 72; respiration 18; temperature 98.6° F. Dry hot air was again administered.

"Same day, 6 p. m.—Patient was and had been entirely comfortable. Pulse 83; respiration 18; temperature 99° F. Directed that I be called again if pain recurred, and did not see her again until the next day.

"11th, 10 a. m.—Patient had slept uninterruptedly all night and was feeling hungry. No tenderness was present anywhere in the abdomen except over a small area immediately inferior to the umbilicus. Pulse 72; respiration 16; temperature 98.6° F. Dry hot air administered.

"Same day, 9 p. m.—Patient had been sleeping some during the day, was entirely comfortable and complained of only very slight tenderness on pressure in umbilical region. Pulse 66; respiration 18; temperature 98.6° F.

"12th, 8 p. m.—Found patient sitting up, dressed, sewing. No pain or tenderness upon pressure was anywhere discoverable. Pulse 76; respiration 18; temperature 98.6° F.

"15th, 8 p. m.—Patient called at my office by appointment. Pulse 78; respiration 20; temperature 98.6° F. Examination revealed slight tenderness upon deep pressure over left Fallopian tube; nowhere else. Once more administered dry hot air and requested that she report in three days.

"18th.—Reports that she returned to her work yesterday morning. Feels as well as she ever did in her life, and searching examination betrays absolutely no sign of her late illness. She wrote me a letter from another city two months later, stating that she was, and had been, perfectly well since I last saw her."

Treatment.

Local Dry Hot Air Application.—The patient should be prepared as described in the chapter upon "Technique" for the abdominal application, the apparatus connected and the heat turned on; in fifteen or twenty minutes the patient will be free from pain. The application should last an hour when it is possible to maintain it that long without the induction of undue fatigue, and the temperature should be raised to from 350° to 400° F. When the application is finished the patient is merely made comfortable again in bed, no special after-treatment of the abdomen being required. The treatment may be repeated as often as the pain returns, but should be applied

XXX.—Patient Prepared for Local Application of Dry Hot Air to Abdomen.

XXXI.—Local Application of Dry Hot Air to Abdomen.

twice daily anyway for the first four days, however comfortable the patient may be.

General Dry Hot Air Application.—The technique of the body treatment in this disease does not differ from that usual in this procedure. As the body temperature is usually considerably above normal when the patient enters the apparatus, it cannot always be relied upon as a guide to the duration of the séance or the intensity of the heat; the pulse acceleration and the general effect upon the nervous system must govern. As a rule the treatment should last about half an hour, and the pulse should be accelerated to 125 or 130 beats per minute. It is ordinarily not wise to push it beyond 140 beats per minute, and the phenomena indicating over-stimulation should not be induced. Dilatation of the capillaries of the face, however, should always be induced.

The frequency of administration is governed by the response on the part of the patient. It will usually be well to apply the measure every other day during the first week, after which the interval may be lengthened.

Additional Remedial Measures.

Aside from the ordinary care of the alimentary canal incident to this affection, surgical measures constitute the only means additional to thermaerotherapy that will have to be considered in its treatment.

When the exciting cause is salpingitis, long-continued intra-vaginal applications of the rapidly interrupted current from the long, fine-wire faradic coil through the bipolar electrode, will sometimes give temporary relief from pain, but the writer has not infrequently seen suffering increased for several hours thereby; its use therefore is not to be unqualifiedly recommended in all cases.

The internal administration of drugs for the relief of

pain is almost never called for, and drug stimulation is entirely superfluous when a body apparatus is at hand and usually when the local treatment is employed alone.

The advantages dependent upon the employment of this agent in peritonitis, viz., rapid relief of pain, activation of the blood and lymph circulations of, and restoration of absorptive function to, the peritoneum have been sufficiently dwelt upon to warrant omission of further mention, and anyone who has carried a patient through an attack under ordinary management will be in a position to readily appreciate the value of the service it renders.

PLEURITIS.

Varieties.—Of the pleurisies it may be said, as of peritonitis, that they are usually secondary to some other affection, as pneumonia, pulmonary tuberculosis, malignant disease, etc., and as in peritonitis also, it is evident that the permanent cure of secondary pleurisies will necessarily involve removal of the exciting cause. There is another class of pleural inflammations, however, which seem to originate in the membranes themselves primarily, and which are at times most refractory. They are accompanied by effusion into the pleural cavity and may be divided for thermaerotherapeutical purposes into two classes, viz., those in which the effusion is serous or fibrinous—hydrothorax and "dry pleurisy" respectively—and those in which the exudate consists of pus.

Sphere of Usefulness of Dry Hot Air.—The pleurisies accompanying pneumonia, as we have seen, and pulmonary tuberculosis, as we shall see later, yield rapidly to dry hot air applications, both as regards their symptomatology and intrinsic pathology.

Enough cases of hydrothorax and "dry pleurisy" have also been treated to demonstrate that this agent is capable of rendering valuable assistance here; that aspira-

tion will have to be done less frequently under such management, and that when it is done the return of the pleural membranes to normal structure and function will be quicker and more frequent than it is at present. A very convincing case was reported by Burwash in the Chicago Medical Recorder for December, 1901. The diagnosis indicated by the physical signs was confirmed by withdrawing some of the fluid through an exploring needle, and the patient was ill but four weeks from the inception of the attack to its termination. The effusion was extensive enough at one time to produce dyspnœa and interference with the heart action. The local application only was used and diuretics and strychnia were administered in combination therewith.

The treatment of pyothorax, however, is, always has been, and of course always must be, operative interference; but many cases refuse to recover even when resection has been done, and there is reason to believe that dry hot air is capable of reducing the number of these incurables and of greatly hastening recovery in all post-operative cases. As these patients are usually debilitated subjects, it is always wise and sometimes necessary to invoke the influence of the body treatment upon general metabolism, as well as the direct effect of the local application upon the pleuræ.

Treatment.

Local Dry Hot Air Application.—The local treatment should be used twice daily for an hour at from 350° to 400° F., until improvement is manifest, and once daily thereafter, until recovery is complete. The preparation of the patient and the technique are the same as have already been described in the section on pneumonia.

General Dry Hot Air Application.—The body treatment should be applied two or three times weekly ac-

cording to the effect upon the patient's general condition, and the technique is that usual to this procedure. As the bodily temperature is not ordinarily much elevated in this affection its fluctuation during the séance will usually be of value in determining the length of the treatment and the intensity of the heat required.

Additional Remedial Measures.

The other methods of physical therapeusis are rarely of value in pleuritis, and the dietary, drug, and surgical management of the disease do not differ from those commonly incident to the affection, except that anodynes and stimulants are very rarely called for when dry hot air is obtainable.

SYNOVITIS.

Varieties.—The vast majority of synovial inflammations are due to one of four etiological factors, viz., trauma, rheumatism, gonorrhea, or tuberculosis. The writer's experience with dry hot air in this affection has been confined principally to cases owning the three first-mentioned causes, and it has been eminently satisfactory.

Sphere of Usefulness of Dry Hot Air.—It is hardly necessary to state that a case of synovitis of any sort should be gotten under treatment as early as possible. If the traumatic form is attacked by dry hot air within three or four days after the injury has been sustained, the pain will be relieved at once and the case will ordinarily reach a successful termination within three weeks. I have never seen one last over six weeks even when ten days had elapsed since the injury, and Corwin has reported one case of acute synovitis of the knee in a boy fifteen years old, exciting cause not stated, which recovered completely with but two treatments. It is the writer's belief, however, that such a rapid response is very rare, and he has personally never seen a case of

true synovitis, whatever the etiology, recover in such a short time however early it came under treatment.

In the rheumatic variety, on the other hand, rapid response is the rule when appropriate medication accompanies the dry hot air; the pain is relieved at once, and recoveries with but four or five applications are not at all uncommon.

In gonorrheal synovitis it is of course, essential that treatment be directed against the primary focus of infection as well as the joint mischief, but the use of dry hot air on the joint affected will greatly hasten the recovery and ankylosis will usually be avoided thereby. This is one of the situations wherein the agent cannot invariably be relied upon to effect immediate relief of pain; it sometimes makes it worse for several hours afterward. The ultimate result attainable justifies its application even under these circumstances, however, unless the pain is exacerbated to an unendurable degree.

Tuberculous synovitis is the most resistant of the varieties to this as to all other methods of therapeusis. A cure requires from two to six months, but in the majority of the cases so far reported the joints have eventually been restored to useful function, and that without operative interference. If surgery has finally to be called upon the prospect of ultimate cure is greatly increased if dry hot air has been applied, because of the improvement in the local nutrition effected by this measure.

Walton has reported most excellent results in tuberculous synovitis, and although our experience has been slight, yet it has encouraged us to undertake further investigation. One case in particular responded most happily. The patient, a boy seventeen years old, had been afflicted with tuberculosis disease of the knee-joint for several years and for the preceding four years had been under the most approved treatment. He came to the

sanitarium with the leg in a splint and the joint ankylosed. A course of local and general dry hot air applications, extending over a period of five months, restored seventy-five per cent of the normal motion to the joint, enabled him to dispense entirely with the splint, stopped his daily temperature elevations and night-sweats, increased his body weight, and, in short, brought about a condition of normal health. Near the close of the course of treatments this patient was exhibited by the writer before the Clinical Society of the New York School of Physical Therapeutics.

It has been said that dry hot air is contra-indicated in joint tuberculosis, but as this statement is not warranted by the pathology of the condition, the physiological action of the agent, or actual clinical experience, it may be dismissed from further consideration.

Treatment.

The knee is the joint most frequently affected in synovitis and the local treatment the one most frequently indicated.

Local Dry Hot Air Application.—The apparatus designed especially for this joint would seem to be the one most likely to be useful in this situation, but for the reasons stated in Chapter III. the general local apparatus will give better results when the joint is susceptible of sufficient extension to permit of its use. The technique appropriate to the special knee apparatus is fully described in Chapter III., in the section that treats of this machine.

When the general local apparatus is used the wrapping should be started at the toes, and the whole of the limb, from the toes to a point a little above the middle of the thigh, invested in three thicknesses of the toweling. The limb is then placed in the apparatus, the limiting attach-

ment fastened around the middle of the thigh, and the heat run up to about 400° F. Whichever apparatus is used, the treatment is continued for an hour and administered twice daily, or oftener if the pain becomes troublesome.

After-Care.—In the traumatic variety, after the application has been completed, it is wise to wrap an elastic bandage about the joint just tightly enough to produce a slight, even pressure, and this should remain in place until the next treatment.

In rheumatic synovitis no compression or immobilization device is called for. It is desirable only that the patient refrain from moving the part, and this he will ordinarily do of his own volition.

When the exciting cause is gonorrheal infection, the persistent pressure of an elastic bandage can rarely be borne, but it is advisable to secure immobility of the joint by applying a splint or some retaining apparatus until the acute inflammatory process has subsided. Passive motion may then be employed immediately after each treatment.

Whether or not immobilization shall be applied in tuberculous synovitis must be determined, of course, by the conditions obtaining in the individual case.

General Dry Hot Air Application.—The body treatment is always extremely helpful in synovitis of any sort, but it is rarely imperatively indicated in cases due to trauma or rheumatism; in gonorrheal cases, however, recovery is always markedly hastened by its employment, and frequently a satisfactory result cannot be attained without it. We have here a condition comparable in many respects with that obtaining in local septic infection, and the technique of the application here is the same as that described for septic infection.

Much the same may also be said of tuberculous syno-

vitis, in which disease the writer is of the opinion that the body treatment should always be employed. We have here not only a localized process, but an impairment of the vital functions generally, and, as we have seen, no measure is more effectual in combating a general debility or local infection than the judiciously administered general dry hot air application.

Additional Remedial Measures.

Electricity, in the form of the Morton static wave current, the static spark, or galvanism, is very useful in traumatic and rheumatic synovitis, the efficiency of the modalities being in the order in which they are named. The high frequency current has been used considerably abroad in all varieties of synovitis and good results reported, but dry hot air, alone, or in combination with one or more of the above-mentioned agents, will ordinarily give results which leave little to be desired when the lesion is due to trauma or rheumatism.

The Morton wave current or the brush discharge will sometimes give good results in relieving the pain of the gonorrheal variety, but operative interference constitutes the most important curative adjunct to be considered in this condition.

The dietary and general management of a case of synovitis that is being treated by dry hot air does not differ from that ordinarily indicated, except in the greatly-lessened frequency with which pain-relieving drugs are required.

NEURITIS.

Etiology.—This affection is another of those owning a varied causation. Prominent among its causes are excessive use of certain sets of muscles and nerves, which is exemplified by the brachial neuritis sometimes en-

countered among penmen; the presence of abnormal substances in the blood, illustrated by the neuritis of nicotinism, morphinism, alcoholism, plumbism, and the infectious fevers; and traumatism. Lithæmia and other constitutional aberrations are also met with among its causative phenomena, and there can be no doubt that sudden chilling of the body under certain conditions will inaugurate an attack, although the manner in which it does so is not entirely clear. A neuralgia so induced would not be difficult to understand, but in the case of a true neuritis it would seem as if something else must also be etiologically involved, and it is probably through an inhibitory influence of cold upon general metabolism, whereby abnormal and irritating products are developed in the circulation, that the attack is provoked.

Treatment.

It will readily be appreciated that removal of the exciting cause is a necessary factor in the attainment of a cure.

Dry Hot Air.—The use of this agent in neuritis is, on the whole, somewhat disappointing. The local application or the dry hot air douche will nearly always relieve the pain for a time, but it almost invariably returns after a little as badly as ever, and we have never been able to convince ourselves that it possessed much, if any, value as a curative agent. The body treatment is more useful, however, and especially in those cases dependent upon constitutional causes it is fairly efficient. Even at the best, however, dry hot air alone is not a very reliable measure.

Additional Remedial Measures.

Electricity.—The best results are obtainable with the electrical currents in combination with thermal applica-

tions, and our routine treatment is to apply the body treatment two or three times weekly and some electrical modality twice daily, except on the dry hot air days, when one electrical treatment is omitted. The local application of heat is used *ad libitum* when the pain is troublesome, in those cases wherein experience demonstrates its value.

The electrical modalities used are the sinusoidal current, the static wave current, the brush discharge and spray in recent cases, and sparks and weak galvanic currents in chronic cases. Some authorities do not countenance the use of galvanism in neuritis, and in many cases it will unquestionably make the trouble worse. In other patients, however, currents of from three to ten milliamperes will just as unquestionably produce beneficial results, and if a case is not doing well under other measures we believe that it should be cautiously tried.

The rapidly interrupted current from the long, fine-wire coil is excellent for sedation, but we have never observed that it exercised much, if any, curative influence in true cases of this disease.

Diet.—The regulation of the ingesta will depend upon the conditions obtaining in the individual case as regards idiosyncrasy, and whether or not constitutional and diathetic factors are involved in the etiology.

Drugs.—Medicines are not efficient against a neuritis, *per se,* but they are useful for removing some of the constitutional conditions upon which it frequently depends, as lithæmia, plumbism, etc., and for relieving pain. They will rarely be required for the latter purpose when dry hot air and electricity are available, but when they are required pyramidon, the coal-tar derivatives, and aspirin will usually give good satisfaction. As the affection very frequently becomes chronic, the administration of morphine should be reserved for a last resort and

given most guardedly then. Its after-effects are frequently most vicious as far as the neuritis itself is concerned, to say nothing of the very present danger of making an *habitué* of the patient.

Physiological Rest.—Suspension of function of affected parts is always helpful and sometimes imperative for restoring the nerve to its normal condition.

SCIATICA.

Causation and Pathology.—Pain in the sciatic nerve and its distribution exhibits sufficiently characteristic clinical features to entitle it to special mention, and as it is more often a neuritis than anything else it will not be out of place to consider it here. It is caused by a variety of factors, prominent among which may be mentioned tumors in the pelvic cavity or spinal canal so located as to press upon the structures that go to make up the sciatic nerve; pathological conditions of the lower lumbar or sacral vertebræ; disease processes affecting the hip joint; inflammatory processes in the nerve itself, its sheath, or those divisions of the spinal nerves which combine to form it, set up by traumatism or the various general systemic toxæmias; adhesions between the nerve and its sheath resulting from antecedent inflammation; and excessive irritability of the nerve centers in the lumbar cord, such as is sometimes met with in general or sexual neurasthenia.

Sphere of Usefulness of Dry Hot Air.—A correct comprehension of the etiological factors present in a given case is most helpful from a therapeutical standpoint, and a little vigilant investigation will usually suffice for its acquisition. The cause of a sciatica, rather than the sciatica itself, should constitute the main point of attack. If it is an intra-pelvic tumor the sciatica will, of course, not be susceptible of anything but temporary removal

until the exciting condition has been disposed of, and in the management of this variety of sciaticas, dry hot air has very little part. In the management of the others, however, it plays a rôle of varying but always considerable importance, and its effects are both indirect and direct.

Its indirect effects are manifested in the sciaticas which are caused by such diseases as arthritis deformans, general systemic toxæmias, etc., which are susceptible of being influenced happily by the body dry hot air application, the sciaticas disappearing as the primary condition improves.

Its direct effects are manifested in sciaticas of traumatic etiology, where the pathological processes are confined to the nerve itself or its immediate vicinity, and are susceptible of being influenced by the local application.

Its use in the first-mentioned class of sciaticas will be therefore its use in the disease causing them, for the description of which the reader is referred to the sections treating of those diseases; its employment in the last-mentioned variety, or those conditions in which its direct effect is useful, is all that will be mentioned here.

Illustrative Case.

The case following is one of indefinite etiology, but shows of what dry hot air is sometimes capable in this ailment.

Mr. M. T. M., seventy years of age, consulted us September 24, 1898. He had suffered constantly with "sciatic rheumatism" for the preceding four years. The exacerbation of the pain produced by bending the hip joint was such that he was obliged to ascend a flight of stairs by placing both feet upon one step at a time, and the pain was in evidence most of the time when at rest.

He had tried various methods of treatment, under both professional and lay guidance, with no satisfactory results.

We treated him with the usual drugs, including salophen, for a few weeks with very slight benefit, and then administered local dry hot air applications in conjunction with gram doses of salophen three times daily. Ten minutes after the first treatment was commenced the constant throbbing pain ceased. At the conclusion of the séance he was able, for the first time in many months, to place the foot belonging to the infirm leg upon the opposite knee to lace his shoe, and to walk downstairs without pain or stiffness.

Two days later he returned for another dry hot air treatment, reporting that he had felt a few slight painful twinges that morning, but nothing else since the first application, except when ascending a flight of stairs.

Two days after he called again by appointment, reporting that he had had no pain at all since the preceding application, and that friends whom he met on the street were remarking that he "didn't walk lame any more." Pain was provoked by extreme flexion of the thigh upon the body, but by no other manipulation. A local dry hot air application was administered and the patient directed to return in a week anyway, and sooner if symptoms returned.

At the end of a week he returned and reported having had no pain or stiffness of any sort or degree since the preceding treatment. Leg was movable in any direction and to any normal extent, and no pain was provoked by manipulation of any sort. Had been accidentally wet through twice since his last visit and been unable to change his clothing for some hours afterwards, but this event, which would have formerly been the cause of severe symptoms, had been followed by no unpleasant sequelæ. Dry hot air was once more administered and patient discharged, with instructions to call again immediately if any more trouble appeared, which he promised to do. Ten months afterwards he was still well, but we then lost track of the case and do not know

his present condition. It is reasonable to suppose, however, that he would have called again had his trouble recurred.

Treatment.

Dry Hot Air.—The management of true sciatic neuritis not dependent upon gross surgical lesions, is practically the same as when neuritis occurs anywhere else, except that drugs are useful only as pain-relieving agents as far as the lesion itself is concerned. Rest of the affected leg is rather more frequently called for, and the general dry hot air application two or three times weekly constitutes an important element, as do also the other forms of physical therapeutics. In many cases the disease will not yield until the last-mentioned agents have been added to the therapeutical regimen.

Electricity.—For recent cases the static brush discharge for twenty or thirty minutes, or the wave current localized over the nerve back of the trochanter for the same length of time once or twice daily until the acute stage has subsided, does good service.

For the chronic cases, long, thick sparks over the course of the nerve, or counter-irritation with the massage roller or brass ball electrode, may be alternated with the wave current every day or two. Sparks must be applied cautiously as they will aggravate the trouble if used too soon, and some cases will be aggravated by them at any stage. In chronic sciatica, however, judiciously chosen and applied static modalities are of more value than any other measure with which we are acquainted, excepting dry hot air and vibratory stimulation. The immediate relief of pain which usually follows static and dry hot air applications to cases in which the focus of inflammation is located *outside the pelvis* is one of the happiest of therapeutical experiences. *When such focus is intra-pelvic,* however, much time, patience

and perseverance will be necessary, as the lesion cannot be reached directly by local applications, and the body dry hot air treatment becomes the main reliance.

Opinions vary as to the advisability of using the continuous current in acute sciatica, and, as a matter of fact, when dry hot air, mechanical vibratory stimulation, or static electricity are available it will seldom have to be considered at all. The usual immediate relief of pain due to its application is unquestionable, but this is frequently followed after some hours by an aggravation of the same. In cases where these agents cannot be used, however, and even in some cases where they can, the continuous current is useful, and may be administered as follows:

The positive pole should usually be applied, stabile, over the nerve at a point peripherad to the limit of the painful area, which usually means back of the ankle, and the negative, stabile, over the sacro-iliac synchondrosis on the affected side. The nerve is thus made anelectrotonic, its sensibility diminished.

The current strength should be from five to twenty-five milliamperes, according to the the patient's tolerance, and the application should last for from ten to fifteen minutes. Stronger currents are likely to produce irritation enough to aggravate the symptoms. Very rarely in acute cases, but more frequently in chronic, the reversed polarities give better results, both as to sedation and permanent benefit. Which can be ascertained only by trial.

The rapidly interrupted, magnetic-induced current from the long, fine wire coil and the sinusoidal current act powerfully as sedatives in this condition and sometimes seem to accomplish positive curative results.

It should be remembered that in some cases of this disease any application of any electrical current will

make the subjective condition worse at any stage of the trouble, with the exception of the static wave, which I have never known to cause, or heard of causing, anything but benefit. It is needless to say that when such a case is encountered, electricity should be kept religiously away from it.

Mechanical Vibratory Stimulation.—One of the most useful of all of the elements of physiotherapy in the treatment of sciatica, is mechanical vibratory stimulation. The writer has accomplished with it some results in sciatica that he is satisfied could not be attained by any other means, and believes that its scientific, rational employment will very greatly increase our power to overcome this sometimes most obstinate affection. For information regarding the theory and practice of its employment the reader is referred to "Vibratory Stimulation," by the late Professor M. F. Pilgrim, and published by the Lawrence Press of New York City, the first publication upon the subject and a thoroughly reliable treatise.

Immobilization.—Confining the patient to his bed and splinting the affected leg for several weeks, thereby suspending its function, is a measure that has sometimes been recommended, and which may be tried in cases that resist the measures outlined above. The writer has never used this plan and is not, therefore, competent to discuss it.

LITHÆMIA.

Definition of Term.

This term is sometimes used as a synonym of gouty diathesis, but the two conditions are not identical. The latter term should be restricted to the condition occurring in persons who inherit the tendency to impaired trophic nerve function, which results in suboxidation of meta-

bolic products and which usually goes on to eventuate in paroxysms of true articular gout while the former should be used to indicate a condition in which the presence of suboxidation products in the system is the result of errors in living in one whose heredity is untainted, and in whom the condition has not existed long enough to induce the characteristic constitutional phenomena of true gout.

Etiology, Pathology, and Clinical Characteristics.

Although the symptomatology of these two classes is nearly if not quite, identical in their early stages, yet the prognosis and response to treatment are very different. In lithæmia the natural tendency is toward recovery, and if the exciting causes, viz., excesses and faulty habits of life, are corrected, the condition will disappear. If, on the other hand, the patient persists in his errors, the condition may go on to the production of true gout, or one of those diseases so closely allied to it—diabetes mellitus or obesity; or he may become a neurasthenic wreck. A surprisingly large proportion of the neurasthenic cases encountered are traceable to impaired function of the trophic nerve centers dependent upon a systemic toxæmia induced by intestinal indigestion, or inability to do the work forced upon them of some other of the viscera concerned in the nutrient function—in short, the presence in the body of an intolerable amount of the products of suboxidation or putrefaction.

In the true hereditary gouty diathesis the tendency is not towards recovery, but towards a gradual increase in the frequency of occurrence and severity of the symptoms. The vitality of the trophic centers is constitutionally impaired, and however careful the victims may be in their habits of living, the majority of them ultimately become chronic invalids and die of nephritis, apoplexy,

or some other gouty *finale,* after months, and sometimes years, of suffering.

As far as we know, however, the neuralgias, dyspepsias, hemorrhoids, chronic bronchitis, etc., of lithæmia and the true gouty diathesis, in its early stages at least, are due to the selfsame direct etiological factors, suboxidation and intestinal putrefaction. Confirmatory of this view is the fact that all the measures which have ever been productive of anything like permanently satisfactory results in these conditions have had increase of metabolism, i. e., oxidation, as one of their prominent effects, elimination of putrescible foods from the dietary, or decrease of the matter ingested which would put an undue burden upon the oxidative capabilities of the organism, as their object. Regulation of diet, combined with judiciously directed exercise, has always been the sheet anchor of treatment.

Chemical experiment and clinical experience have also shown that increasing the alkalinity of the blood renders more soluble, and hence more susceptible of excretion, the suboxidized products present in lithæmic subjects, and the alkali-lithia preparations have gained reputation in the treatment of the condition because of their capacity for accomplishing this end. The large amount of water which accompanies their administration also facilitates removal of the offending matters by its solvent influence in the tissues of the body, and its diuretic effect upon the kidney.

Therapeutic Indications.

From the foregoing it will be seen that the management of lithæmia resolves itself into the employment of measures tending to secure, first, a limitation of the nitrogenous matter ingested; second, an increase in the oxidation processes whereby waste products retained in

the blood and tissues may be rendered more susceptible of excretion; and, third, a rehabilitation of the trophic nerve centers, functional impairment of which has maintained the derangement of metabolism throughout the organism.

Treatment.

Diet.—The first object is obtained by regulating the ingesta according to well-known rules, and the daily ingestion of plenty of pure water, at least a quart per day, should constitute an unvarying element in the management of every case.

General Dry Hot Air Application.—For the attainment of the second there is no measure equal to the body dry hot air treatment, either in efficiency or rapidity. We have already noticed its powerful influence in stimulating metabolism, and in rehabilitating, reconstructing, and invigorating an exhausted nervous system, hence a mere mention of the facts will suffice here. The rapid withdrawal of such a large quantity of fluid from the body as would be represented by the perspiration induced, and the circulatory activation, also play no small part in the general metabolic stimulation excited, by reason of increase in volume and rate of the circulation in all the tissues of the body. In this connection it acts the same as general massage, but much more profoundly.

Elevation of the body temperature is rarely, if ever, present in uncomplicated lithæmia, hence the technique of the body treatment is simple and has been fully described in the section devoted to that subject. Modification will be required only with those patients whose arteries have become atheromatous, and then only to the extent of using a less intense degree of heat and running it up more slowly for the first three or four séances. The degree of heat eventually attained should be at least

350° F., and the period of the application should depend upon the pulse acceleration and the degree of hyperthermia induced.

Electricity and Hydrotherapy.—Other physical measures which are efficient in removing the primary pathology of lithæmia, are the static electrical modalities, hydrotherapy, and the radiant heat bath, but, in the writer's experience, no one of them has equalled dry hot air applications. The static modalities and autocondensation are of very great assistance in combination with it, however.

Drugs.—The mineral waters, salines, and agar-agar (see page 223), are the best agents to employ against the constipation which is usually present, and this condition should invariably be looked to. Free action of the bowels is of the utmost importance in lithæmia.

Immediate symptoms, such as neuralgia, indigestion, irritable bladder, etc., will rarely call for special attention after the first week of dry hot air treatments, but when they do their management does not differ from that ordinarily applicable.

Exercise.—Judiciously regulated exercise is a necessary accompaniment of any management of this disease.

GOUT.

True gout is not common in this country, and the writer has had very little experience with the agent in this disease. Our transatlantic colleagues see a deal of it, however, and some of them speak highly of the use of dry hot air in its treatment. Walsh, of Edinburgh, Scotland, has used it a good deal, and reports as follows:

"The present writer has witnessed remarkable results, following the application of the superheated air in gouty cases. It will control even acute gout, and in one case an incipient attack in the great toe was treated with so

much success that the patient, a stockbroker, was enabled to keep his engagement at a shooting party next day. That result will speak volumes to all who are familiar with acute gout. In advanced and chronic cases the restoration of movement and return to health has often been of a most striking nature. Under the superheated air uratic deposits and enlarged bursæ often vanish.

"A somewhat extensive experience has convinced the present writer that the Tallerman method yields curative results in gout that cannot be approached by other therapeutic measures."

It would seem that the physiological action of dry hot air, especially of the general application, was particularly well adapted to remove the pathological conditions obtaining in true gout, and the hope that it may prove to be of value upon further acquaintance seems justified by what is known of its practical clinical effects.

NEURALGIA.

In the treatment of no condition is the correct diagnosis of causative factors more essential than in that of the various neuralgias. As the scope of this article does not include diagnosis, the truth of the above statement will merely be indicated by calling attention to the fact that neuralgia may be provoked by a variety of causes, prominent among them being general debility, resulting in impaired nutrition of certain nerve trunks; certain degenerative processes in the spinal nerve-tracts; degenerative changes in the nerve trunks themselves, and pressure from tumors. Another rare cause is disease of some of the internal organs, which produces the sensation of pain in the remote distribution of a nerve trunk, the pain-conducting fibers of which are so situated in the cord as to be susceptible of influence by pain im-

pulses traversing the nerve supply of the affected organ, the so-called "referred pains."

Treatment.

Dry hot air enters the problem in two ways; it is efficient in removing some of the primary causes in the form of the body treatment, and in mitigating the local condition in the form of the local application. I will say here that, as the local application cannot be applied directly to the head, it is useful in cephalalgia, only when this is dependent upon some systemic condition which is amenable to the influence of an application to the general body surface or in the form of the dry hot air douche.

General Dry Hot Air Application.—In the neuralgias of general debility, body dry hot air treatments are of transcendent value. The pains usually lessen, and sometimes disappear entirely during the first séance while the patient is in the apparatus, and not infrequently the removal is permanent. Its influence in this situation is, of course, due to stimulation of the trophic processes throughout the body, and the determination of a large quantity of blood laden with nourishment to the starving nerve.

Neuralgias due to the presence of abnormal substances in the blood will nearly always yield temporarily to local treatments when in accessible situations, but their radical removal will usually demand the body application. This acts, of course, through its power of inducing rapid elimination, as well as sedation of the nerve irritation and acceleration of normal metabolism.

Local Dry Hot Air Application.—When the painful part is accessible, as the intercostal nerves for instance, and the primary cause is a general debility, the local application will almost always relieve at once, and sometimes the result is most happy as to permanence. The

writer has seen an intercostal neuralgia of fifteen years' standing entirely cured by three local dry hot air treatments.

This measure will sometimes also afford temporary relief in pain affecting the distribution of nerves pressed upon by tumors, but only removal of the primary cause, of course, will result in permanent cure.

The technique of both body and local treatments in neuralgia is simple, and has been fully described in Chapter III.

Electricity.—The electrical modalities, especially those derived from the static machine, vie with dry hot air in the treatment of neuralgia, and in some situations, as about the head, supplant it entirely in many cases. Where it is appropriate, its much greater convenience of administration makes it preferable to dry hot air, and it is always of value in connection with it. Temporary relief of pain, at least, can almost always be secured by electrical applications, and cases of even the intractable "tic-douloureux" have been reported as cured by them. The writer has never seen a case of true "tic," however, in which anything short of resection of the nerve or total removal of the gasserian ganglion afforded complete and permanent relief, but it is sometimes a matter of great comfort to be able to afford the sufferers even short respites without operation. Dry hot air has so far scored no successes in this affection.

Drugs.—The medicinal treatment appropriate to the various primary conditions causing neuralgias should accompany the physical measures, and the final result is much hastened thereby; neither alone will accomplish the results attainable with both together. As indicated previously, surgery will also have to be called upon at times to extirpate exciting causes, as tumors, etc.

MYALGIA.

This affection is really a neuralgia or a neuritis affecting the nerve fibres ramifying in a muscle. It is usually due to systemic toxæmia of some sort, and the treatment is the same as for neuralgia in other situations. The static wave current or spark will usually alleviate the pain more rapidly and thoroughly than any other measure, and dry hot air applications, both local and general, stand pre-eminent among the means for removing both secondary symptoms and primary causes.

VARICOSE ULCERS.

Varicose ulcers are directly due to impairment of the local nutritive function or local circulatory stasis, but these, in turn, are due to constitutional debility or degeneration of some sort, and atheroma, the gouty diathesis, and lithæmia play an important part as predisposing conditions in many cases. The direct etiological factor is most frequently traumatism, the effects of which the crippled circulatory function is unable to repair.

Treatment.

Local Dry Hot Air Applications.—Local applications of dry hot air constitute one of the most effective single measures known for the local management of the condition, and, in ordinary cases, will effect a cure in from three to six weeks. The cure will not usually be permanent, however, unless the constitutional conditions upon which the local lesion depends are also removed or lessened.

The technique is that usual to the local treatment, except that the temperature rarely need be higher than 300° F. The frequency of application will depend entirely upon how the sore responds. At the beginning it

should be applied every other day. If no improvement is noted at the end of ten days it may be increased to every day. When an appropriate constitutional treatment has accompanied the local dry hot air applications, the case will be a rare one which does not exhibit marked improvement in three weeks.

General Dry Hot Air Applications.—It is always wise, and sometimes necessary, to administer the body treatment once or twice weekly to patients suffering from varicose ulcers. We have already considered the different phases of its physiological action, hence it is only necessary to recall the constitutional etiology of varicose ulcer in order to appreciate the manner in which the body treatment is beneficial.

Electricity.—The electrical modalities alone are of great assistance in the management of the condition under consideration, but, in combination with dry hot air, their effectiveness is doubled.

The negative pole of the galvanic battery, applied directly to the ulcerating surface with from two to ten milliamperes of current according to the patient's tolerance, is extremely effective in producing repair of the local lesion. Enough current to cauterize should not be used. Electrolysis is what does the work, and cauterization will but hinder progress.

The static wave current localized upon the sore is nearly as effective as galvanism, and possesses the advantage of exerting a marked constitutional influence for good. The brush discharge is also very effective, in some cases appearing to do even better work than the wave or galvanism. Sparks to the ulcer enjoy something of a reputation as a curative measure, but the writer has seen ulcers that were attempting to heal repeatedly break down again under their application, and has abandoned them entirely in this connection. The high frequency

current bids fair to prove useful, but it has not yet been used enough to make reliable conclusions possible.

Drugs and Surgical Dressings.—The administration of appropriate drugs for their constitutional effect, and the application of appropriate antiseptic dressings, should always accompany the physical measures, but "strapping" or other *stimulating* measures are entirely uncalled for when physiotherapy is available.

A properly adjusted *supporting* bandage, however, is entitled to profound respect in the treatment of varicose ulcers. Dr. Leonard Woolsey Bacon, formerly Instructor in Operative Surgery at the Yale Medical School, was wont to tell his classes that he did "not care who" prescribed the local medication in varicose ulcers as long as he was "permitted to apply the bandage." He employed the so-called alternate spiral reversed bandage and, as may be gathered from the above quotation, his results were eminently satisfactory.

OTITIS.

Hopkins, of Cleveland, O.; Beck and Oaks, of Chicago, Ill.; Schloss, of San Francisco, Cal.; Sverzhevsky, of Moscow, Russia, and others have reported very good results from the use of dry hot air in affections of the ear. The author has had no experience with the agent in this situation, and the following is extracted from one of Dr. Hopkins' excellent articles upon the subject. The case reported below had remained well for five years at the time of publication, and was treated with a very crude apparatus, instead of the modern finished product described in the chapter upon "Apparatus."

"The patient, John L., aged fifty-three, a carpenter, with excellent family and personal history, has never been seriously ill, but has had nasal catarrh for fifteen years, and gradually increasing deafness for ten years.

"Examination revealed a typical case of hypertrophic rhinitis. The watch tick could be faintly heard with the watch in very close contact with the left ear. The tick could be heard to a distance of three inches from the right ear. The left ear was selected for the test.

"Diagnosis: Chronic catarrhal otitis media, with sclerosis and displacement of the tympanum, anchylosis of the ossicles, slight dilation of the Eustachian tube, and some labyrinthine involvement.

"The diagnosis was confirmed by two colleagues of reputation as aurists before treatment was instituted. Regular, systematic treatment, continued for two years before this experiment was made, had scarcely stayed the progress of this disease.

"Treatment: The ear was thoroughly cleansed with alcohol for several days before treatment was instituted. The patient was then seated in a comfortable chair, the ear examined and found perfectly clean. Narrow strips of dry gauze were placed into the ear, and a large pad of dry gauze placed over the ear. The ear was then covered with a canvas sleeve hot air conductor, and a current of air sent into the canal at a temperature which gradually attained 400° F.

"The temperature was easily borne, if gradually increased, until a high point was reached; the only discomfort attending the treatment arising from a severe headache which followed it, but which was promptly relieved by a dose of codein.

"Following the hot air treatment, the Eustachian tube was always inflated with a warm stimulating vapor from a Globe nebulizer, vibratory massage with the nebulizer completing the treatment.

"The patient was not allowed to leave the office for a half-hour after treatment, and the ear was tightly packed with warm cotton before he went out.

"The nose and pharynx received appropriate treatment with antiseptic washes, etc.

"Treatments were continued on alternate days for three months, at the end of which time he could hear the watch tick distinctly at thirty-four inches, and surprised his friends by invariably replying to their whispered references to him.

"The right ear was then similarly treated, and in ten weeks an equally good result was secured.

"Examination showed that the ears were normal in appearance. The patient was discharged January 6, 1897, and careful tests made at frequent intervals since have shown no tendency to recurrence.

"As to the philosophy of such a cure by this agency, little can be said at this time, but it seems certain that the intense heat stimulates the circulation through the blood supply on the posterior side of the manubrium, causing absorption of the articular deposits, removing atrophy and relieving the rigidity of the tensor tympani. The ossicles lie so near the surface that they receive the full benefit of heat applied to the tympanum, and adhesions between portions of the ossicular chain and the adjoining bony walls of the middle ear are readily removed.

"Naturally, much better results are secured in the same period of time in hypertrophic cases than in those characterized by hyperplasia; but many cases of the latter type, which would ordinarily have been regarded as hopeless, have gradually improved under this treatment until marked benefit was secured.

"As to the results which may reasonably be expected from the judicious and skillful employment of the agency with good appliances in cases of chronic catarrhal otitis media, it may be said:

"(1) That as an exclusive treatment it is rarely of much value in bad cases.

"(2) That when indicated and judiciously employed, in conjunction with other measures of recognized value, it will give results which would be utterly impossible without its aid.

"(3) That when employed with care it is absolutely safe unless contra-indicated.

"(4) That it is of little value in old subjects who have extensive labyrinthine involvement.

"(5) That it stimulates absorption of articular deposits, removes atrophy, and relieves rigidity of the tensor tympani.

"(6) That it acts more favorably on the ossicular chain than on many other articulations, because of the exceptional proximity to the surface.

"(7) That arteriosclerosis and serous effusions into the tympanum are usually contra-indications, and always contra-indications to the inexperienced operator."

The technique of dry hot air applications to the external auditory canal is fully described in the appropriate section of Chapter III. Dr. Hopkins speaks of the use of additional remedial measures as follows:

"Every case must be treated as a whole. He who neglects the appropriate treatment of the naso-pharynx is doomed to disappointment.

"Antiseptic washes must be used. All abnormal conditions must be rationally treated. Constitutional measures, when indicated, must not be neglected. Inflation of the Eustachian tube with a warm, stimulating vapor from some good apparatus like the Globe nebulizer is usually imperative.

"It is well to practice Eustachian inflation and vibratory massage of the middle ear with medicated vapor from the nebulizer after each hot air treatment, being particular that the vapor is warm. A warm vapor is easily secured by connecting the compressed air heater in service with the nebulizer, sending the compressed air first through the heater and then through the nebulizer.

"Careful attention to all details brings most gratifying success in the form of gradually and steadily improved hearing and gradual disappearance of tinnitus.

"A single detail neglected may cause absolute failure."

Professor E. L. Vansant of the Philadelphia Polyclinic has been treating headache, deafness, and tinnitus aurium due to Eustachian and middle ear catarrh, by syringing the nasal and accessory sinuses with dry hot air, for some years, with excellent results. He reported the following case before the Section on Otology and Laryngology of the College of Physicians of Philadelphia, February 21, 1906.

"The patient, Mrs. H. G., a strong, well-built woman, aged 38, a Russian by birth, visited my clinic at the Philadelphia Polyclinic on February 15, 1905. She complained of a very sore throat, with pain in the head and left ear, associated with a very loud buzzing and roaring in the same ear. The symptoms had existed for several days. Her previous history was that of good health, except some muscular rheumatism. She had never had any previous trouble with her throat or ears.

"Examination showed an inflamed, swollen left tonsil with swelling and congestion of the left lateral and posterior pharyngeal walls. The nasal septum was slightly deflected to the right and the turbinals on both sides were swollen. The left membrana tympani was slightly congested, but otherwise normal.

"Appropriate treatment was instituted and after some days the patient reported feeling well except for the otalgia and tinnitus. The tinnitus was apparently very severe; she seemed greatly distressed, saying that it interfered with sleep and caused her much confusion. She was referred to the ear department of the hospital in the early part of March, 1905. The patient visited the ear clinic with great regularity; she states she went three times a week during the first spring, twice a week during the summer, and occasionally during the autumn.

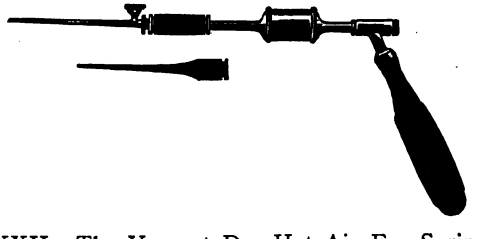
"I am informed she received the most careful attention, the treatment consisting of massage to the ear drum, politzerization, and also the occasional use of the Eustachian catheter. In addition to this treatment six carious teeth in the upper left jaw were, by direction, extracted.

"The patient returned to my clinic in the latter part of November, stating that she could get no relief from the tinnitus, that the noise in her head kept her miserable, and requested to have something further done for relief. She was then placed in the hands of one of my assistants, who was directed to inflate the ear by means of the Eustachian catheter and heated dry air. This he did three or four times, but although the patient felt somewhat better, she was not relieved of the tinnitus. Not being satisfied with the working of the apparatus at the hospital and wishing to assure myself that the patient was thoroughly treated, I directed her to apply to my office for treatment. At her visit, using my usual covered metal, Eustachian catheter and hot-air apparatus, I thoroughly inflated the left ear with heated dry air, using about 20 pounds pressure.

"The patient did not reappear for six weeks, when she again visited my clinic for a fresh head cold, and stated that she had not had the slightest noise in her ear since the day I treated her.

"Since then I have kept the patient under observation and up to the present time she remains entirely free from otalgia and tinnitus."

He describes his apparatus and method of application as follows:



XXXII.—The Vansant Dry Hot Air Ear Syringe.

"The hot-air syringe consists, as you see, of a small chamber containing in some instances a piece of carbon, in other instances having in its interior several dia-

phragms of metal. This chamber is held over a flame, preferably that of a spirit-lamp, until heated. Coming off of the chamber, anteriorly, is a nozzle with adjustable tips. The air enters the chamber from behind and is heated while passing through. The instrument is small in size and is held by a handle placed at a convenient angle. The air to be heated is obtained from the usual air-condenser. The amount of heat produced may be varied at will, from a mild warmth to a burning degree, and depends upon how hot the chamber is heated, how swiftly the current of air is passed through, and how close the nozzle is held to the surface to be treated. In some instances vapors of chloroform, menthol, etc., have been added to the heated air; this done by placing a small quantity of the medicament in the little cup found on one of the tips, or by placing it direct in the catheter, when one is used.

"In preparing the nasal chambers for treatment, the mucosa is first shrunken by applications of cocaine or eucain, used alone or followed by watery solutions of the suprarenal capsule of the sheep.

"The hot air is directed against the openings of the sinuses, or, if necessary a small catheter is used. When the middle ear is treated, the air is passed through a Eustachian catheter.

"The treatment, when properly carried out, is not painful, but is rather agreeable to the patient."

CHAPTER XI.

MISCELLANEOUS CONDITIONS.

TYPHOID FEVER.

Up to the present time very few cases of typhoid fever have been subjected to dry hot air therapeusis, hence the time is not ripe for judgment as to its influence over the primary infection *per se;* but it is, at least, very useful in some of the conditions that obtain during the course of the disease. Myositis, neuritis, and neuralgia, occurring in situations other than about the head, are readily amenable to the local application, and the exhaustion, always threatening and frequently eventuating in dissolution, which sometimes occurs late in the disease, can be controlled, at least in some cases, by the body treatment. The writer has seen life saved under these conditions when the patient's extremities were cold and clammy nearly to the trunk, the *facias Hippocratica* present, pulse running from 150 to 160 beats per minute, a body temperature of 106° F. obtaining, and the sufferer entirely unconscious. The immediate effect of the treatment was to re-establish the circulation in the extremities, bring back the color to the face, and to strengthen the pulse and heart action to an astonishing degree. The body temperature was increased half a degree by the treatment, but it dropped to 105° F. within two hours, and the patient began to improve after the second treatment, given twelve hours later, eventually recovering from one of the worst attacks of typhoid that we have ever witnessed. She had, altogether, five body treatments, and

we are fully persuaded that she would have died had they not been administered.

Another very pretty instance of the stimulating influence of this agent is the manner in which it overcomes the collapse that sometimes follows cold baths. Cold baths exert their beneficial influence through a stimulation of the deep spinal reflexes, but sometimes the nervous system is too much overwhelmed by typhotoxin to be able to react, and depression results. The body dry hot air application exerts its beneficial influence in the same way, but never under any circumstances is its judicious, skillful administration followed by secondary depression. It is worthy of more extensive trial, and the facts already at our command afford grounds for the hope that it will prove to be of considerable use in the treatment of this affection in the future.

The phenomena of over-stimulation are easy of induction in this situation, and the utmost care must be exercised in the administration of the agent not to exceed a limit appropriate to the individual case. The pulse and body temperature are valueless as guides to the duration and intensity of the treatment, and the general response on the part of the patient must govern. The art which is the result of experience is invaluable in this connection.

LA GRIPPE.

The body treatment, applied every other day at a temperature of 350° F., will usually completely eradicate the disease in from four to eight days. The first séance will extinguish the pains entirely, and they will rarely return; the bronchial and nasal symptoms respond at once, and the prostration will have disappeared inside of twenty-four hours to such an extent that the patient can often return to his occupation at once. Comfort is secured immediately, and the slow convalescence extending over a

period of weeks not infrequently under other methods of treatment, is encountered with the utmost rarity when the affection is combated with dry hot air. The temperature usually continues slightly elevated for a day or two. The writer can say, with a conviction born of personal experience, that the field of therapeutics offers few more delightful and satisfactory possibilities than are realized by the treatment of influenza with this agent.

ALCOHOLISM.

A glance merely at the physiological action of body dry hot air applications will demonstrate their exquisite applicability to ordinary cases of alcoholism. I know of no agent that will so effectually allay the nervous symptoms, produce such refreshing sleep, and place the patient so quickly upon his feet.

The induction of the phenomena of over-stimulation is sometimes very easy in these cases; the pulse and temperature go up very quickly, and the patient must be watched very closely during the first and second treatments. A fifteen-minute séance, with a temperature of 275° F., is sometimes all that it is judicious to administer, and the writer has seen a pulse of 160 beats per minute and an increase of 3° F. in the body temperature follow even this mild application. In other cases, on the other hand, the séance will have to be prolonged; the idiosyncrasies of each individual patient will have to govern on these points. Regulation of the ingesta and the administration of drugs should accompany the thermal applications as indicated.

OSTEOMYELITIS.

Burwash has reported two cases occurring during the course of typhoid fever as cured by local dry hot air treatments. He concludes his report as follows:

"Osteomyelitis is always a very grave disease; the prognosis is so uncertain in any case that the physician is placed in a position of such great responsibility that he feels his helplessness, so that any treatment that will give relief to this serious disease in the first stages is eagerly adopted. The early operative treatment, by cutting down through the bone and into the medullary cavity, to remove the focus of inflammation and disease, is often the only hope for an early extirpation of the disease, but this procedure is not always an easy matter for the surgeon to adopt in private practice.

"The hot air treatment does not interfere with an operation if suppuration develops, while it may be the means of completely arresting the disease in the first stage, and thus obviate the necessity of an operation."

MYOSITIS.

Most commonly encountered during the course of the acute infectious diseases and as the result of traumatism. The local application will usually prove most satisfactory for its management, relieving the pain and spasmodic tendencies at once. It may be applied every twelve hours for the first two days and once daily thereafter until the muscle has regained its normal condition. (For illustration of its action see page 159.)

PLUMBISM.

The following is reported by Corwin:

"Philip B., Italian, aged forty-two. Admitted with diagnosis of plumbism, which had not reached paralytic stage, but muscles crampy. One full bath relieved above conditions, and after four baths patient was discharged well."

The administration of potassium iodide or whatever other drugs are indicated should accompany the dry hot air treatments.

SYPHILIS.

A few patients suffering from this affection have been treated with this agent and have responded well. Corwin reports a case of multiple syphilitic arthritis which had resisted other therapeutical measures for several months, as cured in three months by local applications in combination with potassium iodide internally. Relief of pain was immediate and permanent.

The body treatment is the application that should be used generally in this disease, and mercury, potassium iodide, or salvarsan, according to indication, should be thoroughly administered in combination therewith. The general tonic effect of this measure, exerted through its influence upon assimilation, metabolism, and elimination, affords good grounds for the hope that its addition to the therapeutical armamentarium of syphilis will enable us to shorten materially the period of time during which it is now necessary to keep these victims under treatment in order to effect a cure.

GANGRENE.

Gangrene is commonly due to a cutting off of the circulation of the part affected, as in embolism; or extensive impairment of the nutrient function of the blood vessels supplying the part affected, as in atheroma and exemplified in senile gangrene of the extremities. The condition also obtains occasionally in some grave constitutional diseases, as diabetes mellitus.

Dry hot air treatments, both body and local, are of great assistance in combating gangrene, and, as would be expected from the character and profundity of its physiological action, the body treatment is most efficient.

That the local treatment alone is capable of removing the affection most satisfactorily in some cases, however, is demonstrated by the result attained in the fol-

lowing instance, which was reported by Morse, in the New England Medical Monthly for May, 1898:

"Mr. D. Fargo, aged seventy-nine years, farmer by occupation, was attacked with gangrene (senile) in the left foot. There was nothing in his personal or family history worthy of any particular mention or having any bearing on the case. Patient, while cachectic-looking, weak, and apparently in a precarious state of health, showed no other organic trouble save the heart—lungs, stomach, liver, apparently being normal. Urine contains some earthy phosphates, but no albumin or sugar. Patient noticed his trouble first in August, 1897. His family physician made no particular diagnosis and on that account refused treatment.

"Physical examination of the two middle toes, which were affected, revealed quite a deep ulcerative process, involving also the adjacent structures of the dorsal side of the foot. Aside from the general sloughing the toes were practically dead. Poultices, cauterization, and antiseptics proved of no avail. Amputation was out of the question, on account of the existing heart trouble (mitral insufficiency), which was quite pronounced. Then decided symptoms of blood poisoning set in. Add to this the general weakness, due to disease and age, and it was evident that any harsh surgical procedure would almost to a certainty be followed by shock and death.

"All I could do was to dissect away the sloughing tissue and treat the wound antiseptically. The condition assumed a worse form, the leg becoming œdematous from the knee down and hyperæsthetic. Constitutional treatment was prescribed, but all to no avail. I despaired of the case and gave an unfavorable prognosis.

"Then an idea struck me—would intense dry heat not alter the local condition? I had previously investigated this agent for rheumatic and articular affections, and immediately ordered an apparatus from Frank S. Betz. On arrival of the apparatus the limb up to the lower third of the thigh was wrapped in a towel and put into the cylinder, and the air within heated gradually to 350° F. Two treatments a day were given, the tempera-

ture reaching later 400° F., for two weeks. Continuous observation proved a decided diminution of the œdema, healing by granulation of the sloughed tissues, and improvement of the septicæmic symptoms. Patient was discharged cured in two weeks, to everybody's surprise, and at the time of writing, is working on his farm."

Dieulafoy reported to the Paris Academy of Medicine, on February 15, 1910, on a new method of treating diabetic gangrene with dry hot air. His report was published in the London Lancet, May 7, 1910.

On September 14, 1909, he saw in consultation a man, aged sixty-four years, suffering from gangrene of the left leg, which extended as high as two finger breadths below the knee. The leg was cold and livid, and no pulsation could be felt in the popliteal or tibial arteries. The symptoms began with severe pain in the leg on the 12th. The patient had suffered from diabetes for twenty years, and in twelve months had lost 46 kilogrammes in weight. Examination of the urine showed that he was passing 82 grammes of glucose and 30 grammes of acetone in the twenty-four hours. The general condition was too bad for amputation to be entertained. The patient was in a state of prostration bordering on coma, and the pulse was 140 and very weak. A strict anti-diabetic regimen, injections of cacodylate of sodium, and, to relieve the pain and induce sleep, veronal and morphine were ordered. The gangrenous part was treated by the application, twice daily, of douches of hot air produced by a special apparatus capable of supplying a current of 50 litres of air per minute at temperatures ranging as high as 700° F. This method has been introduced by Bonamy, Marot, and Vignat, who have used it with great success in diabetic gangrene limited to one toe and in perforating ulcer of the foot attended with moist gangrene of the foot. In the present

case, air at a temperature of 300° C. was applied to the gangrenous parts, the temperature being reduced to 100° C. in the neighborhood of the living tissues. The jet of air was projected a distance of from 5 to 10 centimeters, and each sitting lasted from thirty to forty-five minutes.

The treatment was not very painful and was well borne. After a week the patient was better, the leg was in a condition of dry gangrene, and there was no odor. The amount of sugar in the urine had decreased 3.28 grammes in the twenty-four hours, and the amount of acetone to 9.7 grammes. The temperature of the air douche was increased to 400° C., and on October 17 the gangrenous tissues were reduced in volume, blackish, dry, and odorless. The hot air not only dried up the surface of the gangrenous part, but penetrated deeply, so to speak "cooking" the limb.

On November 17 the treatment had to be suspended for two days, as the apparatus got out of order, and the gangrenous part became moist and gave off a fetid odor. On the 19th the douches were resumed at a temperature of 400° to 500° C., and the gangrene again became dry, the fetor disappeared, and a line of demarcation formed below the knee. The line of demarcation deepened and the gangrenous parts separated from the sound ones. The leg and foot retained their form, but were much diminished in size, black, and shriveled up, like the limb of a mummy. The tibia was bare at its upper part, and a large "window" formed between the tibia and fibula. The patient regained his strength, and on December 21 sugar and acetone had disappeared from the urine. Amputation was performed at the junction of the lower third with the upper two-thirds of the thigh. The femoral artery was found atheromatous and completely blocked by clot. Union

of the wound took place by first intention and recovery was uneventful. In the amputated limb the popliteal artery was found obliterated by arteritis and an adherent clot. The clot was a little organized and contained newly formed blood-vessels and some connective tissue. There was no trace of infection, no small-cell infiltration, and no lymphangitis.

In contrast to this case M. Dieulafoy related an instance of diabetic gangrene of the foot which after three months became moist and fetid. Amputation was performed in the lower third of the thigh. The femoral artery was not atheromatous and contained no clot. The anterior tibial artery was obliterated by endarteritis and a stratified organized clot. The posterior tibial artery was obliterated by organized clot and its inner coat was completely destroyed. The vessel was both filled and surrounded by small-cell infiltration, and was accompanied by lymphangitis. The vascular lesions in the two cases were similar, but in the one treated with hot air the gangrene remained dry, and was not followed by infection, while in the other the life was jeopardized by consecutive infection. The hot air treatment prevents this infection and eliminates the dangers of septic intoxication and septicæmia.

WOUNDS AND BURNS.

There is no method which can compare in efficiency with dry hot air treatments for the hastening of healing in wounds and burns. This statement is confirmed by E. Asbeck, who describes in La Semaine Medicale his method of treating wounds and burns, which he has applied in over five hundred cases with complete success. It is very crude as compared with the employment of a specially constructed apparatus. The wound or burn is first dressed in the ordinary way with sterilized iodo-

form gauze, a pad of wool, and a bandage. It is then exposed to a source of intense heat, such as a kitchen fire, for about half an hour, or until the dressing is rendered perfectly dry. In the case of small wounds the heat from an ordinary Bunsen burner is sufficient. Dr. Asbeck has found that this mode of treatment induces rapid healing without setting up complications. He was led to adopt it from observations made in the tropics on the accelerating action of the intense heat of the sun on the healing of wounds.

CHRONIC BRONCHITIS.

A disease of diverse etiology. When due to general debility, as when it follows after la grippe, or to constitutional aberrations, as lithæmia or the gouty diathesis, body dry hot air treatments are very effective in removing it. The local application, administered as for pneumonia, also possesses considerable value in its treatment. The technique of either treatment requires no special modification. The general tonic, corrective, and eliminative influence of the body applications are well supported here again by general applications of static electricity, the wave current to the spine, sparks to the spine and chest, etc.

The ordinarily indicated drugs should always accompany the physiological measures. In this, as in rheumatism and several other diseases that have been noted, the physiological measures render the drugs active by so influencing the organism as to remove or lessen conditions that cause medicinal agents, unaided, to be inefficient. Neither alone will do the work that can be accomplished by both together, and non-tuberculous chronic bronchitis is sometimes intractable enough to require all the resources at our command for its removal.

FIBROUS ANKYLOSIS.

It has been stated that this condition, when occurring in the larger joints, was not amenable to the corrective influence of dry hot air; this statement was erroneous. One of the writer's early cases was a fibrous ankylosis of the knee, occurring in a boy eleven years of age, resulting from five weeks' confinement of the joint in a splint applied for a fracture of the femur immediately above the condyles. He had been etherized when the fracture was put up, and the after-effect was so prolonged and severe that his parents were unwilling to have the experience repeated. The joint was exquisitely sensitive, however, and the adhesions could not be forcibly broken up except under an anæsthetic. We administered fourteen local dry hot air treatments, following each with a few minutes of passive motion, the excursions being susceptible of a little increase after each successive séance, and the knee regained its normal mobility. Subsequent experience has shown that the body treatment is of assistance in combination with the local application in removing this condition. Several other observers have reported cases of fibrous ankylosis in which this agent effected a satisfactory termination, and its favorable influence over the condition is established beyond question.

The local treatment should be applied every day for a week and then every other day until recovery has taken place. Five or ten minutes of passive motion should follow each treatment, the joint being flexed as much as possible without causing the patient undue suffering. If troublesome inflammatory reaction follows the manipulation, the dry hot air should follow, instead of precede, the stretching of the adhesions. The body treatment two or three times weekly will greatly hasten

the absorption through influence exerted upon the metabolic functions.

The static wave current, static spark, and galvanism are efficient in combination with this agent in hastening the process, in the order in which they are named. Their curative power is exerted through the same channels as that of dry hot air, but here, as in some other conditions, it is much less profound, hence not so effective when used alone.

MALARIA.

The paroxysm of malaria is one situation wherein the general dry hot air application will not produce diaphoresis, or benefit of any kind as far as we have been able to observe. In those occasional obstinate cases wherein the paroxysm persists in returning on the seventh or twenty-first day, however, indicating a low condition of general vitality on the part of the patient, a few of these treatments given between the paroxysms will render good service in removing the general debility, whereupon the quinine and tonics, which should be administered synchronously therewith, will be able to exercise their customary power over the disease and produce a cure. General static electrifications also are often efficient in performing the same service.

ANGINA PECTORIS.

The writer has treated one case of true angina pectoris with dry hot air. In this instance the cause was probably calcareous degeneration of the coronary arteries or of the aorta. When the patient came under treatment he was unable to walk half a block or go up a flight of stairs without provoking an attack, and was utterly incapacitated for performing his ordinary daily duties. After a six weeks' course of body treat-

ments he had improved to such an extent that he resumed his business duties again. He would sometimes be entirely free from pain for two days at a time, and when it did obtain it was not severe enough to demand opiates. He then discontinued his treatment. For some years we still saw him occasionally, and he always reported himself as slowly but steadily improving.

We exercised the utmost care in administering the treatments to this patient, watching the heart action and subjective phenomena very closely. When the pulse had been accelerated to 110 beats per minute the pain would always begin to appear, and if the treatment was continued it would soon rise to an excruciating intensity, compelling the patient to sit up in the apparatus. When the heat was turned off, however, the pain would begin to subside as soon as the pulse got below 110, and we soon adopted the plan of turning off the heat as soon as the pain put in an appearance, without any reference to the amount of hyperthermia induced. No alarming symptoms obtained at any time.

It would seem, from its power of influencing atheroma of the general arterial system, that the general dry hot air application would be of use in treating angina pectoris dependent upon this etiological factor, and the result obtained in this case gives color to the supposition. In view of the almost absolute lack of practical experience with it in this disease, however, and because of the characteristic effect of body dry hot air upon the circulatory system, it should be used with the utmost caution until enough experience has been gathered to make a reliable judgment possible.

Pseudo-angina is most frequently dependent upon general nervous debility or stomach trouble of some sort, and they often go hand in hand etiologically. Body treatments are usually most efficient in removing both

cause and effect in combination with other appropriate measures, especially static electricity. The writer has succeeded in curing entirely patients who had suffered with the affection for five years, and who had exhausted all other known measures of therapeusis.

GENERAL DEBILITY AND THE CONVALESCENT STATE.

It may not be amiss to mention in this connection that recovery from any simple general debility, and convalescence from surgical operations, or the acute exhausting diseases, such as pneumonia and typhoid, and which, especially in the latter, is sometimes prolonged, may be hastened in the most gratifying manner by the use of body dry hot air treatments, electricity, and mechanical vibratory stimulation.

ARTERIAL HYPERTENSION.

We have heard a great deal during the last five or six years about excessive blood pressure, and when it assumes the form of actual cardio-vascular-renal disease it is a problem fraught with seriousness. The phenomenon is probably caused by a chronic auto-toxæmia of some sort, hence the characteristic influences of the body dry hot air treatment are logically indicated.

Clinically the validity of the inference is confirmable. A body treatment every three or four days is one of the most powerful therapeutic agents at our command with which to combat this condition.

The high frequency electrical current in the form of auto-condensation should be administered two or three times a week, and at the same time putrescible foods and alcohol should be eliminated from the dietary. The drug treatment will never need to be considered when the above measures are employed, hence will not be considered here.

PERIOSTEITIS.

When caused by traumatism, this inflammation can frequently be cured by the local application alone, but the writer has seen such gratifying results follow the use of the body treatment that he prefers the latter in the majority of instances. Some cases will not yield until the body treatment has come upon the scene. The aid of the latter should be invoked when the periosteitis is due to infection, or is of constitutional etiology.

GYNECIC AFFECTIONS.

The use of general dry hot air applications in acute infections of the uterine adnexa has already been discussed in the section upon peritonitis, and it is only necessary to say further that the results therein described have been confirmed by many operators, both in this country and abroad.

Polano, Dutzmann, and Burger, of Vienna, Austria, have secured most gratifying results in some cases of old inflammatory processes involving the female pelvic structures of from six months' to nine years' standing, as regards both subjective and objective improvement. They consider that the application affects the exudate as does a hot cataplasm, only far more energetically. In one case in which the exudate was "as hard as a stone," the resultant softening was so rapid that the proper time for incision passed unnoticed and the pus ruptured spontaneously through the umbilicus and into the bladder.

When we recall that the human organism usually rids itself of disease processes solely by an accentuation of normal metabolic processes, the logic of its employment in conditions such as the above becomes quite clear.

The pain of dysmenorrhea during the attack can ordinarily be greatly relieved and sometimes entirely removed by the use of the body treatment at the time.

We have known functional dysmenorrhea of long standing to be relieved for months after a course of body treatments given for some other affection. When the trouble is due to structural peculiarities or organic pathologies of the pelvic organs, however, nothing, of course, will produce a permanent cure but surgical measures. C. Stuart Hutchinson, during the course of an address to the Central District Medical Association of Iowa, in 1900, speaks of body dry hot air treatments in this condition as follows:

"Dysmenorrhea, due to the neuralgic or rheumatic diathesis, inflammation within the pelvis and parenchymatous nephritis, may be relieved by increasing the elimination through the skin and bowels. Repeated baths cause functional hypertrophy of the sweat-glands and eventually enable them to do more work. In colds the congestion of the nasal mucous membrane can be relieved by one treatment. Syphilitics obtain the same results as from the Hot Springs."

Many of the common organic and structural, as well as functional, causes of dysmenorrhea, can ordinarily be removed more efficiently by appropriate applications of galvanic, faradic, and static electricity in combination with dry hot air than by any other measures, surgical or medicinal. It must be administered, however, by one who is experienced and skillful in this particular field, and good judgment must be exercised as to applicability of the agent to the individual case.

MUSCULAR ADHESIONS.

Occasionally met with after fracture of the long bones, where the muscles about the seat of the injury have been lacerated by the ends of the fragments. The local treatment is usually all that is necessary for removing the trouble, but the body application constitutes a power-

ful reserve when the former proves inefficient. Massage, the static wave current, and galvanism are also efficient in this situation.

PAINS OF FLAT-FOOT.

The permanent removal of such pains cannot be effected by any measure save proper support of the sagging arch, but in hastening adaptation of the supported foot to its new conditions, and in relieving the pain temporarily, local dry hot air treatments are very useful. They may be applied every day or two with the technique usual to the procedure. Peckham says, in the Philadelphia Medical Journal for August 10, 1901: "There are many cases of flat feet which still continue to be painful, even after all the measures referred to (mechanical support and gymnastics) have been faithfully carried out, and these are the cases which demand something in addition to the routine treatment. A foot that has borne weight all day is hot, tender, and painful, and all motion is limited. A few minutes of massage is extremely soothing to such a foot. The pain is relieved, the foot is rendered much more flexible, and the gymnastic work can be done with great comfort. If heat is applied just before the massage, the result is even better, and heat alone, without massage, is of the greatest value just preceding the gymnastic exercises. In hospital cases I have used the hot air oven in almost every painful case with much benefit. It has also been of great value in cases of contracted Achilles tendons, where gradual stretching was done, the tendon yielding much more and much easier after an hour in the hot oven."

The various static modalities, the continuous current, and mechanical vibratory stimulation are also very useful in this situation, but have not proven to be as satis-

factory as dry hot air in the writer's experience. We usually apply these modalities in connection with dry hot air, however.

SKIN DISEASES.

The etiology of the majority of the pathological processes which commonly affect the integument would lead to the belief that dry hot air would be immediately useful in their treatment. Experience demonstrates that this is occasionally so, but in the bulk of the cases so far treated, especially in eczemas, marked benefit has not appeared until several weeks and sometimes months after the agent was applied. This may be looked upon as an indication of the fact that in these cases impairment of the trophic nerve centers played a leading part in their etiology, hence the skin disease could not be removed until the general metabolic functions had been gotten upon an efficient basis.

Walsh reports an interesting case of eczema of both hands of long standing. One hand only was subjected to the treatment, but both hands got well; a very pretty illustration of the reflex influence sometimes exerted by this agent. The evidence now at hand indicates that both body and local applications, but especially the body, will prove to be of considerable assistance in the management of skin disease in the future.

OBESITY.

Body treatments have been lauded as a remedy for obesity, but the writer has never seen them reduce weight markedly or permanently, unless a regulation of diet accompanied their administration. He has not yet been able to convince himself that dry hot air increased the effect obtainable with dietary regulation and exercise when used without this agent, and is unwilling, at the present time, to speak in its favor as a remedy for this condition.

CHAPTER XII.

FIELDS OF FUTURE RESEARCH.

The physiological action and what has been demonstrated in the way of clinical results up to the present time, prove that the powers of dry hot air are exhibited in fields but inefficiently covered by other remedial measures and that the agent has been established upon a sound basis as a permanent element in our therapeutical armamentarium. In the field of its possible future usefulness are the following ailments:

ERYSIPELAS.

In Bulgaria it is a common domestic practice to treat erysipelas by holding a red-hot iron or a bare flame close enough to the part affected to scorch the integument, producing a burn of the first degree. Tregubow has adopted this treatment, using the flame of a spirit lamp or a bit of burning cotton which had been previously dipped in alcohol, as the cauterizing instrument, and reports gratifying results. This fact would suggest the use of dry hot air applications in this disease, and the marked benefits which result from their use in other local septic infections afford reasonable grounds for hoping that they may prove useful here. The principles of application and technique would be the same as those described in the section upon local septic infection.

TETANUS.

This is a local infection with micro-organisms in which death results from the action of toxins circulating in

the blood which emanate directly from the germ colonies. It is entirely analogous to ordinary septic infection, and in view of the gratifying influence which is exerted by thermaerotherapy in the latter accident, this agent would seem to be logically applicable here. As far as we know, no cases have as yet been so treated, but in view of the inadequacy of the current methods of management, this affection offers a promising field for investigation.

LUPUS.

Werther and Lichtwitz have reported good results from the use of dry hot air in the treatment of lupus. They employ a temperature of from 150° to 250° F. Werther has found the treatment to be very painful, and administers a general anæsthetic, but the experience of Lichtwitz has been diametrically opposed to this. The physiological action of the agent, and the results of its use in other infections, suggest its application to cases of this disease. The remarkedly favorable results obtainable with radiotherapy in this connection, however, bid fair to displace, for a time at least, almost all other methods of dealing with the affection, and dry hot air will probably not be investigated in this connection further at present.

SURGICAL SHOCK.

One of the means most depended upon for the relief of this condition is the application of heat by means of the hot pack, hot-water bottles placed about the body, etc. By using a dry hot air apparatus, heat can be applied, not only much more easily, but the degree of elevation can be maintained with uniformity, and the application can be made intense enough to produce a degree of stimulation, which, as has already been stated, is not surpassed, and probably not equalled, by that pro-

ducible with any other measure now known. In addition to this, no vicious reaction is to be feared, and it is probable that the body apparatus will be as familiar an adjunct to the surgical operating room of the near future as is the operating table today.

MULTIPLE NEURITIS.

Multiple neuritis is dependent upon a variety of causes, many of which exhibit exquisite possibilities for the body treatment, in combination with other appropriate measures, and the affection is usually troublesome enough, both as regards chronicity and suffering, to assure a hearty welcome for any agent that will increase our present ability to overcome the trouble.

THE EXANTHEMATOUS DISEASES.

In typhoid fever the employment of the body treatment has already been alluded to, and its effects in this ailment would suggest that it might be useful in other diseases of this class. The writer has applied it to one case of measles, occurring in a man thirty-eight years old, with most gratifying results. The rash developed with great rapidity and profusion and disappeared entirely, together with the other symptoms of the disease, which had existed with a moderate degree of severity, in four days after the treatment was instituted, when the patient was discharged cured.

This is an encouraging showing when we consider the severity of an ordinary case of measles occurring in adult life. The great profuseness of the rash, and the rapidity with which it developed in this case, would indicate that influence upon the function of elimination played a large part in the production of the beneficial results attained.

CEREBRO-SPINAL MENINGITIS (Spotted Fever).

A disease of microbic etiology which has been increasingly prevalent in recent years.

Since its introduction by Aufrecht, in 1894, the method of treating epidemic meningitis with hot water baths has been often and favorably reported upon. W. M. Rojansky employed the method in a series of cases, and is well satisfied with his results. The earlier the treatment is begun the better the effect and the lower the mortality. Out of ten patients treated from the first four days only one died—certainly a low mortality percentage. Out of forty-one patients treated with hot baths after the fourth day, sixteen died, making a percentage of thirty-nine.

The immediate effect of the hot bath is very striking, the unconscious patient rapidly regaining his senses. Sometimes this is accomplished after the second or third bath. Delirium and excitement are allayed or disappear entirely. The excruciating headaches yield noticeably to the hot bath and the same is true in a less marked degree of the spinal pains. Insomnia is also favorably influenced. Other symptoms, like fever, vomiting and muscular rigidity, have not been affected by hot baths in any notable manner.

The writer has had no cases under treatment, but the etiology, pathology, and clinical phenomena strongly suggest that the characteristic influences of the body dry hot air application might profitably be invoked in a remedial capacity. The mortality percentage is so high under the management at present in vogue that careful and thorough investigation of the powers of any measure that promises to exhibit helpful properties, would seem to be justifiable and desirable. That the

general dry hot air application holds forth such a promise is evident from a study of its physiological action.

Other local and general disease conditions might be mentioned under this chapter heading, but the above are sufficient to indicate the general lines along which future investigations may be expected to develop results, and the belief is held by those familiar with this therapeutic agent that the prosecution of such investigations will eventuate in the acquisition of helpful knowledge.

CHAPTER XIII.

THE INCANDESCENT ELECTRIC LIGHT.

The precise place which this remedial measure should occupy in the management of disease has not yet been determined, but as the commonly accepted indications for its employment parallel those for dry hot air in many ways, it will not be inappropriate to consider the subject briefly in a work of this character.*

At the outset it should be distinctly borne in mind that the incandescent electric light is by no means the same thing as the electric arc light. The latter is rich in the chemical or actinic rays; the former is very poor in these therapeutic elements and such of these as it is capable of furnishing are absorbed by the glass which encloses the filament before they can reach the patient.

These chemical rays exhibit activities which are of great importance biologically and constitute a sharp differentiation between the therapeutical applicabilities of these two forms of energy.

The incandescent electric light only will be discussed in this work, as the arc light is not, in the prevalent interpretation of the term, a "thermal" procedure.

APPARATUS.

Two forms of apparatus are in general use, one for treating the entire body at once except the head, and another for treating portions of the body.

*Those desiring to go into the subject exhaustively are referred to "Light Energy," by Margaret A. Cleaves, and "Radiotherapy," by Leopold Freund, published by The Rebman Company; "Rational Hydrotherapy," by J. H. Kellogg, published by The F. A. Davis Company; and "Radiotherapy, Phototherapy, Radium and High Frequency Currents," by the late C. W. Allen, published by Lea Brothers and Company.

XXXIII.—Incandescent Electric Light Cabinet for Treating the Patient in the Recumbent Position.

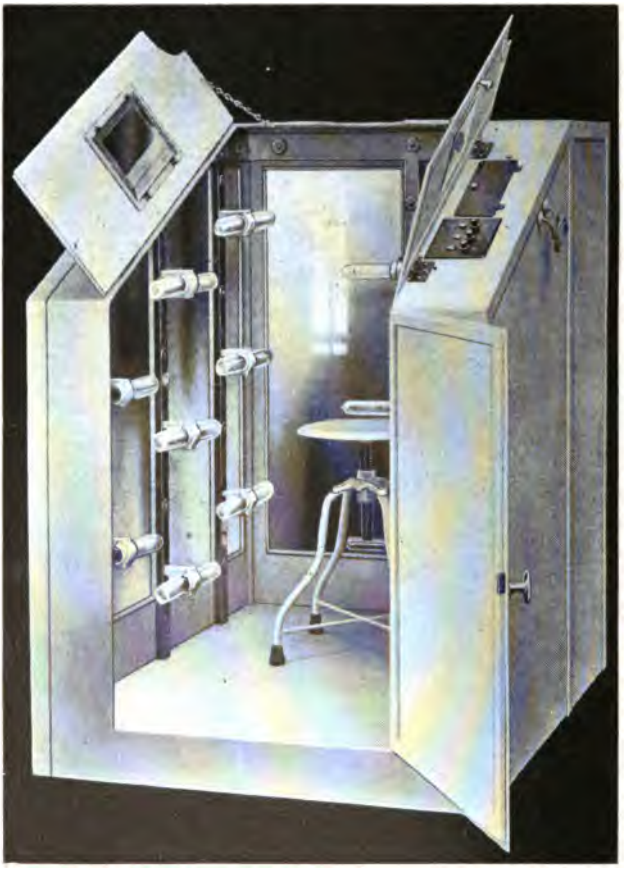
The Body Apparatus.—The first mentioned form embraces two types, one in which patient lies down during treatment (Cut XXXIII), and the other in which he receives the treatment while sitting upon a stool (Cuts XXXIV and XXXV).

One type of apparatus is as efficient as the other, but the patient is usually more comfortable lying down during treatment. We favor administering the measure in

XXXIV.—Incandescent Electric Light Cabinet for Treating the Patient in the Sitting Position.

this position, because we believe production of the characteristic physiological effects to be facilitated by having the patient's muscular and nervous systems at rest and relaxed during the administration, and because the patient will never faint during treatment if he is in the recumbent position. The upright apparatus, however, is at present the most generally used.

Both of the above types consist in general of cabinets, on the inside of which are arranged from twenty to



XXXV.—Incandescent Electric Light Cabinet Made of White Enameled Steel for Treating the Patient in the Sitting Position.

one hundred incandescent lamps (usually of the ordinary 16 candle power type) backed by reflectors so arranged

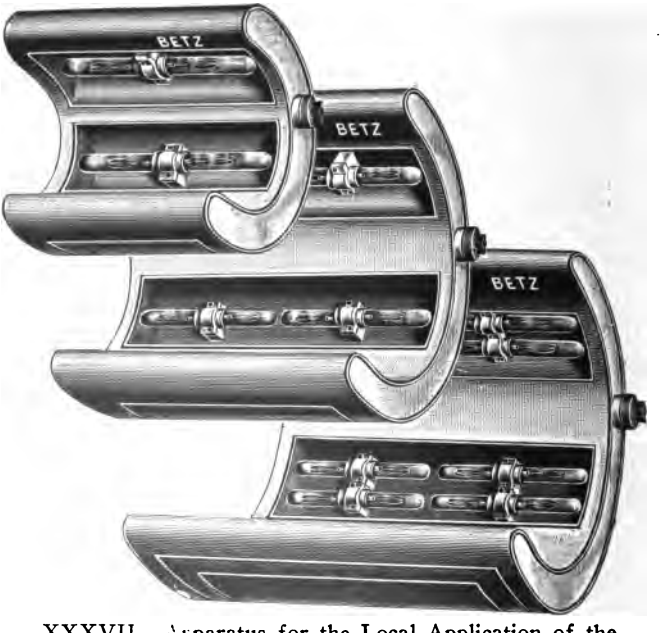
as to throw the greatest possible amount of light upon the patient, and so wired and switched as to render it possible to use any desired number of lamps so as to secure any desired intensity of treatment.

A thermometer is usually conveniently located to in-

XXXVI.—Combination Electric Light Cabinet Fitted with Both Incandescent and Arc Lights.

dicate the degree of heat attained by the air contained in the cabinet, but this is of very little practical value, as it is the *impingement of the radiations from the lamps upon the body* and their penetration *into its depths* that produce the characteristic effects, and not the tem-

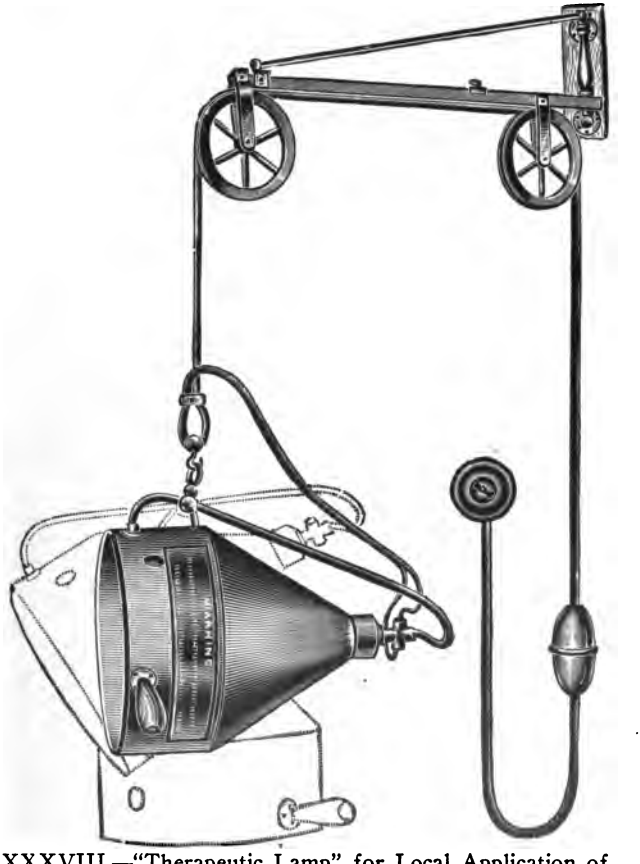
perature of the air in the cabinet. As a matter of fact, raising the temperature of the air in the cabinet to any great extent is of little actual importance, the characteristic effects of the treatment being susceptible of induction while the temperature of the air surrounding the patient is as low as 95° F. Some operators ventilate



XXXVII.—Apparatus for the Local Application of the Incandescent Electric Light (three sizes).

their cabinets freely as a routine practice during treatment, so that the temperature of the air surrounding the patient never rises much higher than that outside of the cabinet, and they report the same results as do those who operate their cabinets so that the air becomes heated.

Combination Cabinets.—Incandescent electric light cabinets fitted also with arc lights, so that one can apply either radiation at will, can be secured from the dealers upon specification (Cut XXXVI).



XXXVIII.—"Therapeutic Lamp" for Local Application of the Incandescent Electric Light.

The Local Apparatus.—This form of apparatus also embraces two structural types, one of which consists in general of a box so constructed that it can be fitted

to that portion of the body which is to be treated, and on the inside of which are arranged two or more incandescent lamps (Cut XXXVII). A key switch is conveniently located for controlling the lamps.

Another (the "Therapeutic Lamp") consists of a more or less parabolic reflector, in the center of which is placed a single lamp of a candle power ranging from fifty to

XXXIX.—Portable Therapeutic Lamp for the Local Application of the Incandescent Electric Light.

five hundred (Cuts XXXVIII, XXXIX and XL). A key switch is conveniently located for controlling the current.

Glass screens which limit the visible rays reaching the patient to blue, red, etc., can be secured from the manufacturers, but so little is known of the real value of these modifications of the incandescent electric light that they will not be discussed further in this work.

XL.—The "Sunbeam" Therapeutic Lamp. Made by the Waite & Bartlett Co. of New York. This lamp *does not focus* the light.

PHYSIOLOGICAL ACTION.

The physiological action of the incandescent electric light has not as yet been studied with sufficient thoroughness and system to render justifiable dogmatic statements regarding its actual therapeutic efficiency.

It is highly probable that psychic influence plays at least a considerable part in much of the therapeutic effect induced (and claimed by its advocates to be inducible), as is the case with all the other more or less spectacular remedial measures. That it produces actual *physical* in addition to the psychical effects, however, is demonstrated by the following modifications of physiological function which follow its administration:

The Body Treatment.

Body Temperature.—The general body temperature is considerably increased if a vigorous application is continued for more than ten minutes (to from two to five degrees F., according to the duration and intensity of the application).

Heart Action.—The heart action increases in frequency if vigorous irradiation is continued more than two or three minutes, such increase being in direct proportion to the length and intensity of the application.

It does not, however, exhibit the same increase in *force* that is so noticeable with dry hot air applications.

Blood Pressure.—It is probably safe to state that when the application lasts beyond the primary irritant stage, the blood pressure is lowered slightly. Different writers are, however, at variance on this point and each operator is at present obliged to base his conclusions upon his own personal experience.

Capillary Circulation.—The rapid reddening of the skin under vigorous incandescent electric light irradia-

tion, demonstrates that intense capillary dilatation has been induced, hence, at least local, activation of the circulation of the part treated.

Composition of the Blood.—Observations upon the influence of this measure upon the blood are so imperfect and contradictory that positive statements are not at present justifiable.

As high an authority as Winternitz,* however, has reported that the red corpuscles, and also their haemoglobin content, at least in anæmic patients, are increased by the incandescent electric light bath.

Metabolic Function.—Haemoglobin gives off its oxygen more readily under the influence of light,† hence the incandescent electric light bath, which floods the tissues of the body with this agent, increases the oxidizing power of the blood and may be assumed to accelerate oxidation throughout the body.

This assumption is rendered still more tenable by the fact that increased elimination of CO_2 has been demonstrated, by direct measurement, to result from the application of this measure.¶

On the other hand, an increase in CO_2 elimination would be induced by the raising of the body temperature whereby chemical reactions are facilitated. In the absence of direct proof in connection with this question, one may make his own choice as to which cause is operative.

Sweat Glands.—The incandescent electric light bath induces profuse perspiration in from three to six minutes.

Vigorous stimulation of the perspiratory function is one property which is universally conceded to the incandescent electric light bath. As a pure and simple "sweat bath" it unquestionably has no superior.

*Blatter f. Hydrotherapie X. Jahr., 1900, H. 6, p. 144.
†Quincke. Pflueger's Archiv. 1894, Vol. LVII. p. 134.
¶Kellogg. Rational Hydrotherapy, p. 176.

Leopold Freund* quotes Below and Aufrecht as reporting having found traces of mercury in the perspiration induced by the incandescent electric light bath in persons who had been treated by mercurial inunction years before. This would indicate that the action upon the perspiratory function is profound.

Urinary Secretion.—Whether or not any constant influence is exerted intrinsically upon the renal secretory function has not yet been determined.

Kellogg† found in one series of experiments diminution in the total quantity of urine, in the urea, total chlorides and total solids and ascribed this diminution to increased excretion of urinary constituents by the stimulated perspiratory function. If a simple stimulation of the perspiratory function can so divert from the urine constituents which would normally be excreted by an organ as highly specialized as the kidney, certainly the measure can not be accused of *stimulating* the renal function intrinsically to any great extent.

Respiration.—The respiration is usually somewhat quickened and rendered more shallow by this treatment.

Reflex Nervous Effects.—In addition to the above we also have those effects due to impingement of the long, non-luminous heat rays upon the nerve endings in the skin, which are identical in kind with those derivable from dry hot air applications, but as their intensity in the incandescent electric light application is much less than in the dry hot air application (the temperature of the air in the electric light apparatus never approaching that which should be used in dry hot air machines), the characteristic effects are correspondingly less pronounced. We have in this therapeutic application, then, a mixture of heat and light effects, as was stated in Chapter II, page 34.

*Radiotherapy, p. 468.
†Rational Hydrotherapy.

The Local Treatment.

The local application produces (1) profuse local perspiration, (2) marked dilatation of the local capillary circulation, (3) some elevation of the general body temperature *in some cases*, (4) increased oxidizing power of the blood, and (5) some degree of local reflex circulatory and trophic exaltation due to impingement of the long, non-luminous heat rays upon the nerve endings in the skin.

It produces no material influence upon the blood pressure, the heart action, the respiration or the urinary secretion.

Rationale of Physiological Action.

Comprehension of the logic of this subject will be facilitated if the following facts are borne in mind:

First, it is only the visible rays of the spectrum (red, yellow and green) and the infra-red rays that are active in the incandescent electric light bath, such small proportion of the ultra-violet and higher frequencies (chemical or actinic rays) as this light contains being practically completely intercepted by the glass surrounding the filament.

Second, whenever a ray of light is absorbed by a substance, *heat is produced in that substance at the point of absorption.*

Third, most of the rays of the visible spectrum are absorbed during their passage through live human tissues, except the red. This can be demonstrated by holding the hand between the eye and a strong light when the red rays are seen to come through plentifully, if the light is strong enough, penetrating even bony tissue in considerable degree.

This form of energy, then, produces its physiological influence in three ways, as follows:

First, by reason of the direct, inherent, biological influence upon the tissues irradiated, of such rays of the visible spectrum as are *not absorbed and transformed into heat* during their passage through such tissues.

Second, by reason of the heat generated in the depths of irradiated tissues by absorption of such of the visible rays as do not pass completely through such tissues.

Third, by reason of its power to modify the functions of the deep reflex nerve centers which are in physiological relation with cutaneous areas irradiated, through thermic irritation of the nerve endings in such cutaneous areas set up by impingement upon such nerve endings of the long, non-luminous heat rays which are present in large measure in the radiation from the incandescent electric light.

As regards the first mentioned, Edwards,* Berthold,† Finsen‡ and others have proven that light, as such, exerts a profoundly accelerant influence upon cell development and organic function.

The second and third mentioned involve merely heat effects and these were discussed at length in chapter II.

Now light and heat facilitate chemical change (oxidation§ and metabolism) and, if not excessive, cellular development and organic function,‖ hence the vital processes of tissues irradiated by this therapeutic agent would be exalted.

*De l'influence des agents physiques sur la vie, Paris, 1824.
†Mueller's Archiv. f. Anatomie und Physiologie, 1850, p. 158.
‡Mittheilgn. aus Finsen's Med. Lichtinst., Vol. I, p. 118.
§Moleschott; Untersuchungen zen Naturlehre des Menschen und der Thiere, von Moleschott, 1881, and Wiener Medinische Wochenschrift, 1885, No. 43.
§Selmi and Piacentini; Rendi conti del Reale Instituto Lombard di sc. e. lettre, 1870, Vol. III, Ser. 11, p. 51, ref. Allg, Med. Centr. Ztg. 1872, p 810.
§Van Pech; Amsterdamer Maandblaad Voor Natuurwet, 1879.
‖Schnetzler; Archives des sc. physiques et naturelles, 1874, Vol. LI.
‖Godnew; Zur Lehre v. d. Einfluss d. Sonnenlichtes auf die Thiere. Kasansche Dissert., 1882.
‖Loeb; Pflueger's Archiv. Vol. LXIII.
‖Finsen; Ueber die Beddutung d. Chem. Strahlen, Leipzig, 1879.

This brings us to the essential difference in the production of the physiological effects of incandescent electric light baths and dry hot air treatments, which is, that incandescent electric light baths *carry light and heat effects deeply into the tissues* under treatment by reason of the fact that many of the light rays penetrate deeply before they are transformed into heat by absorption, whereby local indications of reaction (perspiration, reddening of the skin, etc.) can be produced *without profound reflex influence being necessarily involved,* whereas the vastly greater bulk of the physiological influence of dry hot air is produced by *profound reflex influence* set up by thermic irritation of the numerous nerve endings in the skin.

This power to carry direct light and heat effects deeply into the tissues is believed by many to constitute a great advantage over the induction of exclusively reflex effects. This may ultimately prove to be so as far as the local application is concerned but it is open to grave doubt when the body application is in question.

When a marked reaction follows a body dry hot air treatment one may rest assured that the *deeply located nerve centers,* upon efficient function of which life itself depends, have been forced to *increase the output of their vitalizing impulses,* whereas the same degree of immediately apparent reaction derived from the incandescent electric light bath can be explained by *deeper, more profound local reaction* of the tissues *directly influenced by the light,* a large proportion of which *is transformed into heat* during its passage through the *depths* of those tissues.

Clinical observation of the effects of these measures upon the functions of deep nerve centers in such diseases as pneumonia, local septic infection with profound general toxaemia, etc., in which *depression of vital func-*

tion is marked, indicates that this difference is important and must be reckoned with in the therapeutical differentiation of these two forms of energy.

Other factors which emphasize the reality and poignancy of this difference are (1) the inconstancy and irregularity of the effect of the incandescent electric light bath upon the composition of the blood and urine, as opposed to the constancy and regularity of that exhibited by dry hot air applications, and (2) that advocates of the incandescent electric light bath, almost without exception, demand that the tonic influence of the cold douche following the light bath be invoked in order to "properly complete" the treatment. One never needs the aid of the cold douche to properly complete a properly administered dry hot air treatment.

Direct bactericidal effects have been claimed for the incandescent electric light bath when applied to patients suffering from diseases owning microbic etiology, but as bactericidal properties are confined to the rays of greater frequency (above the violet) than those obtainable from the incandescent electric light this claim may be dismissed without further notice. Indirectly, however, this measure *does* exercise such an influence through its power to activate the circulation,* at least superficially and locally, and to accelerate oxidation and metabolism.

Summary of Physiological Action.

The physiological influence of the incandescent electric light bath, then, may be summarized as follows:

1. It increases the body temperature if vigorously applied for more than ten minutes.

2. It increases the rapidity of the heart action when vigorously applied.

*See chapter VI, p. 131.

3. It frequently lowers the blood pressure somewhat when vigorously applied.

4. It produces an irritant effect upon the nerve endings in the skin which results in (a) dilatation of, at least the superficial, capillaries, hence activation of, at least the superficial, circulation, and (b) some degree of reflex trophic action.

5. Some observers have reported that it increases the number of the red blood corpuscles and their haemoglobin content.

6. It causes the haemoglobin of the blood to part more readily with its oxygen, which may be assumed to accelerate oxidation in the tissues under influence.

7. It increases the output of CO_2.

8. It induces profuse perspiration and does it in from three to ten minutes.

9. Some observers have reported that it decreases the total quantity of urine and the proportions of urea, total chlorides and total solids in this secretion.

10. It slightly quickens the respiration when vigorously applied, but renders it more shallow.

11. It raises the temperature of the skin and, to some extent at least, that of the deeper tissues through which the light passes, hence accelerates oxidation and metabolism, in some degree, in the depths of these tissues.

12. It incites exaltation of function in the protoplasm composing the cells of the organs and other tissues through which it passes.

THERAPEUTIC INDICATIONS.

It will be seen that what has been learned about the physiological action of this remedial agent parallels very closely that of other thermal applications. The degrees in which these effects are produced, however, as compared with the same effects produced by other thermal

applications, notably dry hot air, have by no means been determined in such a way as to justify the claims for its pre-eminent desirability as a therapeutic measure, put forth by some of its enthusiastic advocates.

The only such claim which can be accepted unquestionably is that it is more *convenient* to secure thermal effects by the incandescent electric light bath than by any other means of applying heat.

As the physiological action parallels that of dry hot air so also the varieties of disease in which it promises to be helpful, parallel very closely those in which thermaerotherapy is logically indicated, as follows:

First, those in the treatment of which an increase in the perspiratory function constitutes a desirable element.

Second, those in connection with which it is desirable to activate the capillary circulation.

Third, those in connection with which it is desired to increase the oxidative processes and accelerate metabolism and catabolism.

Fourth, painful conditions caused by local anaemias, toxaemias, or circulatory stases.

Prominent among such diseases are nephritis, diabetes, obesity, gout, rheumatism, arthritis deformans, lithaemia, the various general and local infections and toxaemias, including neuritis and neuralgias except *tic douloureaux*, anaemia, sluggish ulcers, inflammatory exudates, arterio-sclerosis and dropsy.

As a rough, working formula it may be stated, broadly and rather loosely to be sure, that (1) when profound, *deep reflex effects* are demanded (as in the heart failure of intense pneumococcic or typhoid toxaemia, local septic infection with general systemic toxaemia, arthritis deformans, true rheumatism, etc.) dry hot air treatments should constitute the preference over the incandescent electric light bath, and (2) that when the *direct* effects

of heat upon deeply located as well as superficial tissues, are desired (as in inflammatory exudates, sluggish ulcers or synovitis not caused by the systemic toxaemias, etc.) the incandescent electric light would be the logical choice. This will be found fairly reliable as indicating the relative therapeutical applicabilities of these two procedures in the general run of cases.

CONTRA-INDICATIONS.

Valvular heart disease is usually stated to be a contra-indication for the incandescent electric light bath. Personally we have never seen evil results follow a judiciously administered application of this measure to patients suffering from valvular heart lesions *if given in the recumbent* position, but this may be due to the fact that we have not treated many such cases with this procedure. The strengthening and steadying of the heart action and the reduction in blood pressure which almost invariably follow a well administered dry hot air treatment, has led us to prefer the last mentioned application in such cases.

It is easily believable, however, that fainting or syncope might occur if a vigorous incandescent electric light irradiation were administered with the patient in the *sitting* or *upright* position. It is also possible that the penetration of the body by light rays which are transformed into heat during their passage through the *deeply located nerve centers*, might exercise a very different influence than when the light and heat impinged simply upon the *nerve endings in the skin.* In the latter case the effect upon the deeper structures would be *purely reflex* instead of *direct.*

As the majority of writers warn against the use of the incandescent electric light bath in these conditions it will, at any rate, be wise to exercise circumspection when

it is being administered to such patients and terminate the treatment if irregularity of the pulse, sudden marked increase in frequency, or cardiac palpitation ensue, and to watch the patient closely for the development of any after-effects that might be prejudicial.

Recent cerebral hemorrhage is also usually stated to be a contra-indication to this procedure but, for the same reasons stated in connection with valvular lesions of the heart in the first paragraph of this section, we do not feel justified in passing dogmatically upon this point at this time.

TECHNIQUE.

The Body Application.—The patient is placed, naked, in the proper position in the cabinet, the limiting curtain or a towel wrapped loosely around the neck to keep the light in the interior of the cabinet from the patient's eyes, and the desired number of lamps turned on.

It is usually recommended that an ice cap or the like be placed upon the patient's head at this stage of the application as a routine measure, but as cerebral conditions calling for this procedure (throbbing, dizziness, nausea, etc.) have occurred with the greatest rarity in our experience we long ago adopted the plan of waiting for indications for the ice cap to manifest themselves before thus afflicting the patient.

If it is desired simply to warm the superficies of the patient as a preparation for the cold douche, or if only the tonic influence of the light is to be invoked, all of the lamps should be turned on at once and the treatment terminated *just as soon as the skin reddens decidedly or perspiration appears.* This will require from three to ten minutes according to the reactive susceptibilities of the individual patient.

If it is desired to produce profoundly eliminative perspiration, or if a profound influence upon the deep nerve

centers or general metabolism and oxidation are desired, the treatment must be continued for from ten to thirty minutes according to the response obtained.

During the more vigorous applications the ventilating facilities of the apparatus should be utilized to the full but when only the shorter treatments (from three to five minutes) are being administered the ventilation is practically negligible.

A much longer treatment can be given with the patient in the recumbent than in the sitting posture and, as has already been stated, we prefer the recumbent posture for *all* incandescent electric light applications.

During the longer applications with all patients and during the short ones with patients suffering from debilitating conditions or whose cardiac functions are crippled, the pulse should be carefully watched and the occurrence of irregularity or the sudden accession of rapidity and weakness should always be an indication for terminating the application.

Cranial throbbing, dizziness, nausea or faintness indicate the application of cold to the head, but not necessarily the termination of the treatment unless these symptoms become excessive or refuse to yield to the application of cold, or unless the pulse becomes irregular or suddenly rapid or small.

Just how long the treatment shall continue in cases requiring profound influence and how intense it shall be as regards the number of lamps used, will have to be determined for each patient by watching the after-effect. If languor or a heightened pulse persist for more than three hours after the treatment has terminated, the application has been too intense and should be administered less vigorously the next time. Each patient has his own individual index of reaction. It is therefore wise to limit the first application to fifteen minutes and, if no

pernicious after-effects are observed to increase the intensity of subsequent treatments until the patient's maximum reactive capacity is ascertained.

The Local Application.—With the apparatus which is intended to be fixed to the part under treatment and which contains more than one lamp, the technique consists simply in turning on the lamps and leaving the apparatus in position for from half an hour to an hour. There is very little danger of burning the patient with this apparatus if reasonable ventilation is maintained, because the lamps are not located sufficiently near the patient's skin to injure this tissue. If the patient experiences unpleasant burning sensations during the treatment one or more layers of very thin, coarsely meshed gauze may be wrapped about the part and will cut off any excessive irradiation.

The therapeutic lamps should be handled the same as the dry hot air douche described in the earlier part of this work, *i. e.*, a distance between the lamp and the skin should be found at which the lamp can be maintained without exceeding the tolerance of the patient's skin, and it should then be held steadily at that point. Better effects are produced by a steady irradiation at such a distance than by holding the lamp too near and then, when the tissues under treatment protest, holding it too far away, etc.

After-Treatment.

The Body Application.—If the application is intended to produce profuse, long-continued sweating, as in nephritis, the patient should be put to bed between blankets as soon as the treatment is ended.

If it is desired to secure the tonic effect, as in arthritis deformans, general debility and the like, the application should be followed with a cold douche, cold pack, massage, mechanical vibratory stimulation or some electrical

treatment. Which and how many of these applications should be used will have to be determined by the conditions obtaining in the individual case.

Whatever the condition for which the treatment is being given, rest in bed or on a couch for at least an hour and preferably for two hours after the application, should constitute the routine practice.

Local Application.—In acute inflammatory conditions it is only necessary to bathe the part in hot soap and water followed by alcohol and then to dust it with toilet powder. In chronic conditions, more particularly of the joints, the irradiation should be followed by either massage, mechanical vibratory stimulation, electricity or a cold douche, according to the conditions obtaining in the individual case.

Frequency.

In urgent, acute conditions the incandescent electric light baths may be given every day for three days, then every other day for a week and two or three times a week thereafter.

In chronic conditions wherein it is desired to produce a tonic influence or modify metabolism, they should be applied two or three times a week.

The local treatment may be applied anywhere from two or three times a day in acute, urgent conditions, to once every other day in chronic conditions.

Additional Remedial Measures.

Any indications for medication, dietary regulation, etc., should be fulfilled, in *combination* with the incandescent electric light treatments, just as religiously as if the patient were not being irradiated. As in the case of dry hot air, irradiation is but an addition to our therapeutical armamentarium and will not justify us in ignoring other helpful measures.

SUMMARY.

Our present knowledge of this therapeutic modality, then, may be succinctly stated as follows:

First, its physiological influence consists of a mixture of that of the long, non-luminous heat rays and that of the shorter rays of the visible spectrum.

Second, it does not contain the violet rays and higher frequencies in therapeutically active measure.

Third, it differs from the non-luminous thermal procedures in that it enables us to carry direct light and heat effects into the profoundest depths of the human body.

Fourth, it does not exhibit the characteristic physiological effects of the long, non-luminous heat rays upon the deep nerve centers, in the same degree as does dry hot air.

Fifth, as a pure and simple perspiratory stimulant it has no superior.

Sixth, it accelerates oxidation in the body.

Seventh, it activates the superficial capillary circulation.

Eighth, to obtain its maximum tonic effect it is necessary to follow the irradiation with the application of cold in some form.

Ninth, it constitutes the most *convenient* known method of applying heat, either locally or to the entire superficies of the body.

It will be seen that much remains to be ascertained concerning the incandescent electric light, especially as regards its value relative to that of other thermal procedures, but what has been learned to date furnishes a tangible and logical starting point for further investigation and justifies a feeling that this measure may come to be entitled to a prominent and permanent place in the therapeusis of the future.

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